National Aeronautics and Space Administration

Roundup

LYNDON B. JOHNSON SPACE CENTER

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Full STEAM ahead

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On the cover:

On Feb. 7, 1984, in this image taken by his fellow STS-41B crew members aboard the Earth-orbiting Space Shuttle *Challenger*, NASA astronaut Bruce McCandless II approaches his maximum distance from the vehicle. McCandless became the first astronaut to maneuver about in space untethered during this first "field" tryout of a nitrogen-propelled, hand-controlled backpack device called the Manned Maneuvering Unit. In this issue of *Roundup*, not only do we "tip our helmets" to a 50-year spacewalking legacy, we are moving full STEAM (science, technology, engineering, arts and math) ahead to advance human spaceflight by being a center that is lean, agile, responsive and adaptive to change. See our progress in embracing the future as the page turns.

Guest Column

NASA/PHOTO

Melanie Saunders
Associate Director (Management)

ABOUT THIS TIME LAST YEAR, I told you about a new JSC 2.0 pilot program designed to increase employee career development opportunities while giving supervisors a new tool for staffing special assignments.

Well, the Transparent Opportunities Pilot (TOP) was so successful that the JSC leadership team has decided to adopt the program centerwide, phasing it in over the next couple of years. That means there will be more opportunities for employees to shine, and more opportunities for supervisors to help employees develop the skills and talents that will allow them to be our JSC leaders of the future.

TOP, which will become the Transparent Opportunities Program, is just one more tool in JSC's continuing efforts to improve inclusion and innovation. It's designed to increase awareness and make access to those opportunities universal for any employee, regardless of their age, gender, ethnicity, sexual preference or spiritual beliefs. As the 90 percent of employees who have taken JSC's inclusion and innovation training courses know, the likelihood of making good choices increases exponentially when you include a diverse group in the decision-making process. That's why "ask the audience" is the most powerful tool you can use if you're trying to become a millionaire on a TV game show.

The Procurement, Legal, Office of the Chief Financial Officer and Safety and Mission Assurance organizations went "all in" on the pilot program. Some of JSC's largest organizations, such as Engineering and Human Health and Performance, included the major divisions. A total of 675 civil service employees, or about 23 percent of the JSC civil service population, were eligible to participate in the pilot—and 182 got onboard. Each organization defined and tracked "opportunities" and afterward participated in discussions about successes, failures and best practices.

TOP aims to dispel the idea that special assignments are reserved for a chosen few. Being inclusive is about helping others succeed so that the team can succeed. The post-pilot survey showed that 62 percent of those in the pilot were likely to consider new jobs and development opportunities. Those who did not said either that they were happy with what they were doing (38 percent), they thought a leading candidate already existed (16 percent) or that they were too busy with other tasks (12 percent).

When a challenging task crops up, JSC wants all of its team members to believe that they will be seriously considered for those special assignments. There are no shortages of cross-organizational teams, high-profile presentations or acting team lead assignments that might give your career a jumpstart if you feel one is needed.

In pilot surveys, both supervisors and employees shared that there is still room for improvement when communicating development opportunities. Many are unclear about how to go about making progress through a technical career advancement path. Others fear they won't be considered. It was also clear that employees and supervisors had different opinions about the value of certain developmental opportunities. Some opportunities did not draw much interest, which was surprising to the supervisors, as they considered them valuable to gaining insight and becoming more visible to the leadership team. Some employees saw those same opportunities as being valuable to the leadership team—but not necessarily to the employee. A lesson gained is that supervisors need to be very clear when explaining why and how they think a certain opportunity is valuable to an employee's development.

On behalf of the entire JSC leadership team, I want to thank the members of the Ad-Hoc Barriers Committee, who developed the idea for TOP, the JSC Human Resources Office that worked hard to put the pilot program into action and the organizations that participated in the pilot.

If you weren't in an organization that participated in the pilot, new opportunities are coming your way as TOP expands. You never know when a new challenge might be just what you need to provide some positive delta V (increase in velocity) in your career, or a change in vector (direction) that could put you on a new career path. As our employees succeed—no matter their origins, backgrounds or preferences—so does JSC. So get involved, take charge of your own future and help JSC meet the challenges that lie ahead.

NASA/PHOTO

Photo of the quarter:

ESA (European Space Agency) astronaut Samantha Cristoforetti enjoys her first drink from the new ISSpresso machine. The espresso device allows crews to make tea, coffee, broth or other hot beverages they might enjoy.

Laura Niles

Scientists make no bones about first study of osteocytes on space station

RESEARCHERS MAY BE "excyted" to learn that osteocyte cultures traveled to the International Space Station in the spring of 2015 for the first time. With their delivery on SpaceX-6, the Osteocytes and mechano-transduction (Osteo-4) investigation team is analyzing the effects of microgravity on this type of bone cell. Understanding these effects will be critical as astronauts plan for future missions that require longer exposure to microgravity, such as to deep space or Mars. The results derived from this study could also have implications for patients on Earth in the treatment of bone disorders related to disuse or immobilization, as well as metabolic diseases such as osteoporosis.

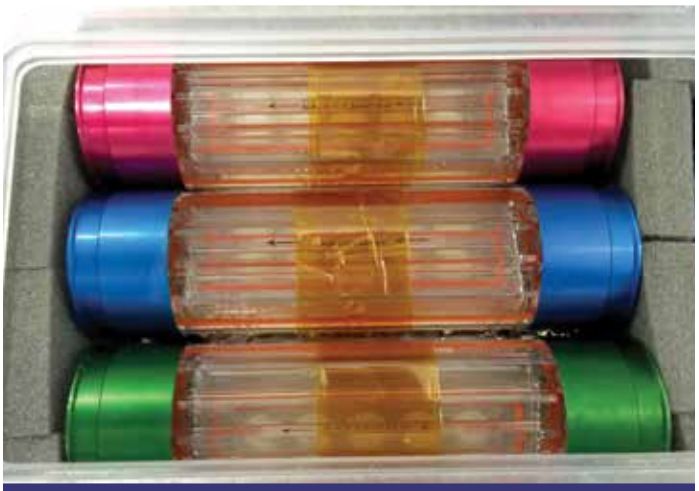


IMAGE CREDIT: DIVIETI PAJEVIC LABORATORY

The three colorful bioreactors where mouse bone cells grow within a 3-D material for the Osteo-4 investigation aboard the International Space Station.

"We are investigating how osteocytes—the most abundant cells in the adult skeleton—both sense and respond to changes in mechanical forces, as achieved aboard the space station," said National Institutes of Health (NIH) grantee Paola Divieti Pajevic, M.D., Ph.D., principal investigator of the Osteo-4 study and associate professor at the Goldman School of Dental Medicine at Boston University.

Through previous spaceflight studies, some crew members have shown a loss of bone mass after long-duration missions in space. Divieti Pajevic's team examines the function and behavior of isolated osteocytes in microgravity to determine how they may contribute to the observed decline in crew member bone density.

Osteocytes are the cells that sense mechanical forces, like weight-lifting, as they are applied to the skeleton. They transform these forces into biological responses, signaling other cells to make or remove bone.

Divieti Pajevic's research team uses samples from a specific line of bone cells from mice that mimic human bone osteocytes in gene expression. Gene expression is the process in which information programmed in a gene is used to direct the assembly of a protein molecule, which then helps carry out the instructions given to the cell for its role. The team will try to isolate the genetic signals changed in the cells once exposed to microgravity.

During the Osteo-4 study, the osteocytes are grown in a synthetic, tissue-like 3-D structure and housed inside bioreactors. Bioreactors are containers used to allow the cells to grow in a protected environment. Three trays each house three individual bioreactors, creating a total of nine samples for study on the space station.

Once the samples arrive in space and are exposed to microgravity, astronauts freeze the cells at intervals of three, five and seven or eight days. Freezing the osteocytes stops changes in the cells and allows the researchers to look at the differences at early and later stages of exposure to microgravity. The frozen samples will return to Earth aboard the SpaceX Dragon for further examination.

The Osteo-4 study, sponsored by the NIH's National Institute of Arthritis and Musculoskeletal and Skin Diseases, the Center for the Advancement of Science in Space and NASA's Kennedy Space Center, is Divieti Pajevic's first space station investigation. The project is funded under the Biomedical Research on the International Space Station initiative, a collaborative effort between NIH and NASA. Osteo-4 also represents the fourth mission for the Osteo series of investigations. Previously known as the Osteoporosis Experiment in Orbit, the research series began as a Canadian Space Agency project on Space Shuttle *Discovery* in 1998.

"For us, the possibility to use the space station is really important to validate the ground-based model that we use in the lab," Divieti Pajevic said.

With this first osteocyte study in space, scientists may better understand the function of these plentiful bone cells. And with the orbiting laboratory planned for operations until at least 2024, this osteocyte project may be the beginning of what's to come.

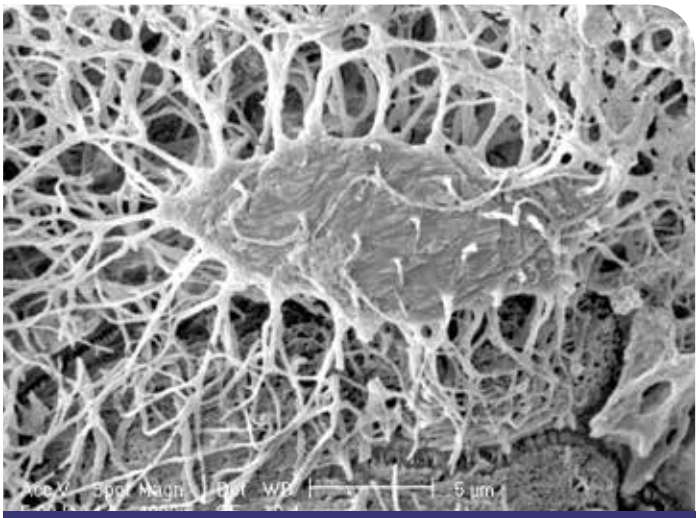


IMAGE COURTESY OF DR. L BONEWALD

A close-up of mouse osteocytes within the bone.

A hard-knock microbial life

By Catherine Ragin Williams

MICROBES HOPING TO HITCH a ride on human explorers or spacecraft to Mars will find it increasingly difficult to be "alien invaders" thanks to an Extravehicular Activity (EVA) tool being modified for deep-space astronauts.

A hot topic within NASA human exploration and science communities is the question of whether humans will negatively impact science objectives. Unlike the robots that are cleaned once and sent on their way to Mars, humans are—well—unclean.

"We're filthy, we really are," said Characterize Human Forward Contamination Project Manager Michelle Rucker, also an engineer. "Humans continually generate microbial contaminants."

Being dirty may be fine and dandy on the ground, where scientists are well aware of environmental factors and the makeup of various organisms. But if you're a scientist on Mars, an organism becomes much more interesting if you're looking for evidence of other life forms. It would be quite terrible to announce you've found *it*—life on Mars!—only to have to retract the statement with an "Oops, we brought the 'life' … never mind."

But before we test for contaminants on other planets, we must first know what contaminants are emanating from suited explorers or spacecraft life support systems such as the International Space Station.

"Last year, the Russians announced there was plankton growing outside the space station," Rucker said. "The station's ECLSS (Environmental Control and Life Support System) isn't closed loop. We vent stuff. But the question is, how much is coming out—and what kinds of microbes?"

NASA/PHOTO JSC2015E064402 ROBERT MARKOWITZ

NASA cooperative education student Mary Walker demonstrates how the EVA swab tool would collect a microbial sample on an EVA glove spacesuit joint, worn by fellow designer Drew Hood.

Gathering data on that would be essential to identifying the gaps in our knowledge, but U.S. explorers don't have a tool for the job. However, within a year or two, they just may.

Enter the gel brush caddy handle, an EVA tool with endless possibilities.

"We support NEEMO (NASA Extreme Environment Mission Operations), and we are developing geology tools to try and minimize cross contamination between samples," said Drew Hood, an exploration EVA tools engineer. "The gel brush caddy has these clickable end effectors. You basically snap them on like a razor-blade assembly. We had already adapted that design to a different kind of venue for geology sampling, so when this came about, we said, 'Hey, we know an existing shuttle component that we've already modified for something else … maybe we can modify it and even piggyback on some of the hardware for it.'"

By using a swab tip at the end of the tool, an astronaut in a bulky spacesuit could easily obtain microbial samples from outside his suit—or even a space station ECLSS vent during a spacewalk. Potentially, we may be able to decipher more than the mystery of plankton in space just by transforming a tool in our exploration arsenal.

"It could be used for more than just looking for bugs on Mars," Rucker said. "You could fly one or two handles and custom make your ends for whatever job you're trying to do."

Though the project began in January, it received accelerated support through recent Innovation Charge Account funding. Mary Walker, a cooperative education student from the University of Kentucky, modeled the end effector using Hood's design specifications and printed a 3-D prototype in a matter of hours.

"Since then, we've changed the design to be as flight-like as possible and have made new prototypes to evaluate," Walker said.

A real test for the tool will hopefully come early next year, where it might have the opportunity to undergo spacesuit testing in a vacuum chamber with a suited subject.

"We're thinking that the most likely place things will squeeze out of the suit is at the joints," Rucker said.

In a vacuum, the differential in pressure will ensure that whatever is within the suit will try to get out. The test subject will then use the modified EVA swab tool to sample the pressurized joints. After chamber testing—the sky is not the limit. Think low-Earth orbit, ECLSS vents and beyond.

"If we do the suit test and find some bugs squeezing out, what we can do is take that type of microbe and stick it in a Mars simulation chamber, pump it down to a Martian environment, hit it with Mars UV and temperature and see what it does," Rucker said. "The conventional wisdom is all those things would probably kill it … but we don't know."

Another possible issue is that on the Red Planet, the shielded underside of our living quarters could be downright habitable to other forms of life.

"We're going to have this nice, snuggly spaceship," Rucker said. "The spaceship-induced environment is different than just the Mars environment."

As Rucker playfully noted, "If we learned anything from 'Jurassic Park,' it's that 'life finds a way.'"

Getting a handle on other organisms before we widely travel the solar system will mean that, hopefully, the only species schlepping to extraterrestrial landscapes will be of the human variety.

Harnessing **energy 2.0**

By Catherine Ragin Williams

WITHIN THE ENGINEERING DIRECTORATE, a cluster of remote buildings house the capabilities to harness energy and its many forms to reach otherworldly destinations. As NASA's targets have changed from low-Earth orbit to Lagrange points and beyond, the Energy Systems Test Area (ESTA) has used the period post shuttle era to transform its operations to support these ambitious goals. The secret of its flexibility, though, can be traced to the common denominator of teamwork.

"We are definitely moving towards a more collaborative environment for development and testing," said Michael Salinas, deputy branch chief for the Energy Systems Test Branch. "It's a very positive shift. We're making modifications to our facilities and workforce to try to help with more of this additional work."

Some of these cutting-edge projects may have a familiar ring to them: propulsion for Morpheus, the lean, green lander that completed free flights at Kennedy Space Center after successfully navigating tethered tests at Johnson Space Center; Orion power, battery and wiring; pyrotechnic bolts for the International Space Station docking system; and the robotic Regolith and Environment Science and Oxygen and Lunar Volatiles mission, or RESOLVE, which will prospect the moon after taking flight in 2018.

But a new undertaking embodying the spirit of JSC 2.0 is showing that ESTA is lean, agile and, moreover, adaptive to change.

Dust to thrust

The Human Exploration Spacecraft Testbed for Integration and Advancement (HESTIA), named for the Greek goddess of the hearth, family and domestic life, hopes to bring life to a Red Planet excursion.

"This is a new initiative that Engineering has been behind for the past year or so," Salinas said. "It's integrated propulsion, ISRU (In-Situ Resource Utilization), ECLSS (Environmental Control and Life Support System) and power generation. A big part of JSC 2.0 is collaborative environments and more innovative thinking. The propulsion team, after getting Morpheus kind of to a closing point, has moved toward HESTIA as a mechanism to start integrating the same type of technologies into potentially lander-type craft. Think things like asteroid retrieval, with a thought of also designing the systems that would lead to a Mars mission."

HESTIA would use commodities found in extraterrestrial realms to not only sustain its human inhabitants, but create propellants, generate power and more.

"The propellants are used for propulsion and as reactants for a fuel cell that generates power, and the oxygen is for the crew breathing," said Energy Systems Test Branch Chief Marty McClean. "The ISRU part is that we create those propellants from local resources, like the soil."

Commonly known as "dust to thrust," resource utilization is a logical step in making far-out missions plausible.

But to test it? ESTA has a chamber for that.

"We have a large, 20-foot diameter chamber called the subsystem chamber, and it can simulate Mars environments," Salinas said.

Pumped down to the same pressures on Mars, backfilled with similar gases and decked out with simulated soil, experimental hardware will be hard pressed to know the difference while undergoing evaluations for the fuel cell system, ECLSS and propellants.

Project success through collaboration

Though the Engineering teams may not be physically together, tech-enabled communication makes it appear so—just as it would to explorers on another planet communicating with mission control.

"We're making data connections that allow us to virtually integrate to Crew and Thermal Systems—to other centers, if need be," McClean said. "We'll be using the ISRU to create the reactants, propellants and commodities. We'll tell them how much we're making, and they'll consume on their side. We don't have to be co-located, but we can do work together."

ESTA will empower NASA's future, whether through ISRU activities or putting next-generation spacesuit batteries through the ringer (and doing everything the labels tell you not to). But what is seemingly bad for the hardware that passes through ESTA is ultimately for the greater good, ensuring failure happens on the ground—and not in space.

For more information on ESTA, visit: http://go.usa.gov/3deSW

NASA /PHOTO JOE BIBBY

Image from the 2012 ISRU RESOLVE mission simulation in Mauna Kea, Hawaii. HESTIA will build on those lessons and integrate advanced engineering concepts to help enable a Mars mission.

A new home for astronaut training

By Gary Jordan

MIKE HOPKINS woke up his fellow crewmates at 4 a.m. There was still much to do before the morning's Extravehicular Activity (EVA), even after beginning preparations 72 hours prior. Reviewing procedures, pre-briefing and suiting up were all on the agenda. Hopkins was particularly well-prepared for the event. After all, he had performed the exact same spacewalk once before.

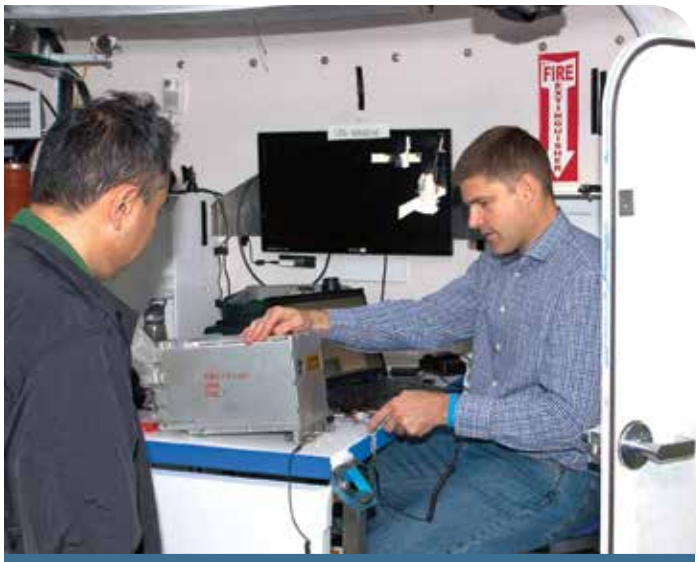
Hopkins would perform a spacewalk almost identical to when he and fellow Expedition 38 crew member Rick Mastracchio replaced a coolant pump module on the International Space Station (ISS) S1 truss—only this time in the Neutral Buoyancy Laboratory (NBL). This was the closing task in an 80-hour long-duration training mission that had kicked off in the Human Exploration Research Analog (HERA) at Johnson Space Center.

During the space shuttle era, crews would train together for around one year, working on typical procedures, running through emergency scenarios and learning to live and work together. Things have since changed, and ISS crew members frequently train separately.

"Sometimes ISS crew members are not in the same country," said Lisa Spence, Flight Analogs Project lead for Space Week. Sometimes one astronaut will train in Russia while another is in the United States.

The JSC Astronaut Office began hosting Space Weeks—long-duration training events—as a proof of concept to potentially counter training separation for future crews assigned to an expedition. The idea is to provide the crew with a true sense of living and working aboard the space station by training in a team environment, all the while experiencing the operational challenges that go along with it.

"We throw in a mix of operations," said Christie Bertels, lead training engineer for Space Week. She explained that one of the biggest challenges crews face is constantly shifting from one type of task to another.



NASA/PHOTO

Japanese Aerospace Exploration Agency astronaut Satoshi Furukawa (left) and Canadian Space Agency astronaut Jeremy Hansen (right) perform maintenance and EVA preparation activities inside the HERA.

"Even when crew members prepare for an EVA, their workdays may still consist of a variety of other tasks, such as maintenance, payloads or medical operations," Bertels said. "One of the biggest benefits of the Space Week training style is allowing the crew to take everything they've learned and piece it all together in a flight-like operational environment."

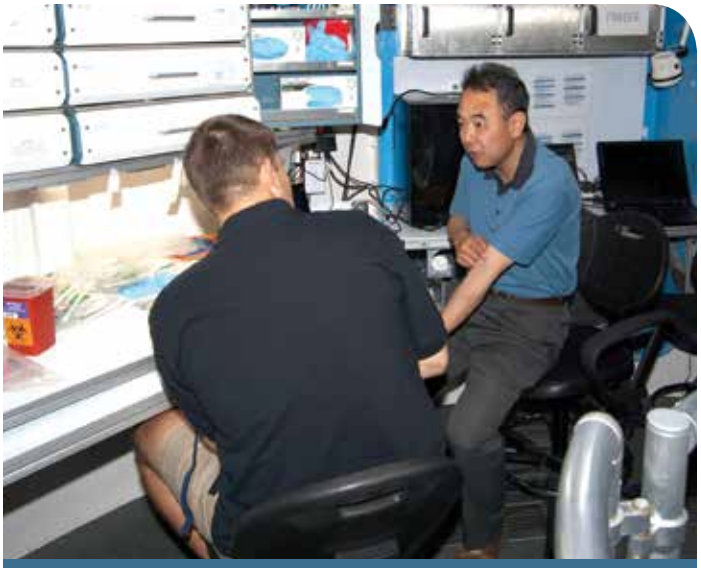
The first iterations of Space Week were conducted in 2014 for the current astronaut candidate class, where they trained in the Space Vehicle Mockup Facility at JSC. The extended stay helped the crew get used to the layout of the station, but there were no designated crew quarters for sleeping.

"The ISS mock-ups in Building 9 provide excellent training, but lack the isolation that crews will experience on orbit," Bertels said.

The Human Research Program (HRP) reached out to Canadian Space Agency astronaut Jeremy Hansen and others in the Astronaut

NASA/PHOTO

The astronaut quartet spent the first day of Space Week preparing for their simulated spacewalk in the Building 9 Quest Airlock mock-up.



NASA/PHOTO

From left, astronauts Hansen and Furukawa experience a flight-like environment of the HERA's confined habitat on the ground.

Office to suggest training in a more immersive setting.

Normally used to conduct HRP research studies, the HERA at JSC allows crews to live and work in an isolated and confined environment. Crews that reside in the space habitat routinely conduct two-week missions about four times a year.

"HERA's main focus is research," Spence said. While the HERA does not typically run missions with astronauts, "we select crew members with astronaut-like qualities. We look at factors that indicate they can successfully live in close quarters with others for the duration of the mission while performing a variety of research- and mission-related tasks."

Current research missions in the HERA simulate a human mission to an asteroid. The crew runs through everything from day-to-day procedures and experiments to rendezvousing with the asteroid and analyzing samples. As the HERA evolves, the space habitat will be able to simulate 30- and, eventually, 60-day missions.

The HERA habitat is a 148-cubic-meter facility with sleep stations for four, a flight-like galley, exercise equipment, hygiene module (complete with hot and cold running water), several work areas and an airlock. The environment is completely self-contained, so when a crew ingresses, they can work and live in an isolated environment for weeks on end.

From May 4 to 7, the HERA housed a diverse crew of four astronauts: Hansen, Hopkins, NASA's Jeanette Epps and the Japanese Aerospace Exploration Agency's Satoshi Furukawa. Furukawa and Hopkins are both spaceflight veterans.

HERA and its mission control were reconfigured to support space station mission operations. Even station flight controllers were tapped for the multi-day simulation.

The HERA's isolated setting allowed the quartet to live and work together using operational tools and procedures, execute flight-like timelines and communicate with a remote team of flight controllers. During the three days, they performed tasks that included spacewalk preparation and other nominal activities. The crew had access to a simulated station computer network and server to view daily procedures as they would aboard the orbiting laboratory.

"It was very beneficial to have the opportunity to run through a procedure that we were not trained for," Hansen said. "It's a good simulation of what will actually happen on orbit. You learn to understand how to weave the team together, when to ask for help and when to handle the task on your own."

Hansen mentioned that the training helped him gain a real awareness of the "small" things, like space food. "You get an understanding for how much you're going to get and what it tastes like."

For the most part, crew members remained inside the HERA for the duration of the mission.

During scheduled pre-sleep—the allotted time to catch up on the day's activities, emails or rest—Hopkins and Furukawa shared experiences from their time spent 250 miles above Earth.

"They would share how to philosophically handle procedures," Hansen said. "There is a lot going through your mind when there are so many different things to do, and you have to be super critical."

On May 7, the crew headed to the NBL to execute the main event—a spacewalk. Hopkins and Hansen simulated the excursion while Furukawa took control of the robotic arm. Epps completed pre- and post-EVA checklists.

Long-duration mission training in the HERA was a win-win scenario for all involved. Astronauts were fully immersed in small-quarters living and work, and HERA facilitators received crucial feedback from the crew about the habitat that will be adapted to future mock missions. Given its practical capabilities, more explorers may call the HERA "home" during future long-duration training runs.

NASA/PHOTO

The latest astronauts to complete Space Week training inside the HERA pose outside their temporary home. From left to right, Japanese Aerospace Exploration Agency's Satoshi Furukawa, NASA's Mike Hopkins, Canadian Space Agency's Jeremy Hansen and NASA's Jeanette Epps.

JSC Education puts student technologies to the test

By Ashlé Harris

SCHOOL MAY BE OUT FOR SUMMER, but Johnson Space Center education specialists are still working to put science, technology, engineering and mathematics (STEM) into the hands of students and educators of all grades across the country. Opportunities are heating up for students to get out from behind their desks and apply the words and equations in their textbooks to real life through cool Education programs.

Making a splash in one of the nation's largest indoor pools

The Micro-g Neutral Buoyancy Experiment Design Teams (Micro-g NExT) made a splashing debut at one of NASA's most well-known astronaut training facilities, the Neutral Buoyancy Laboratory (NBL). The program, a collaboration between JSC Education, the Human Exploration and Operations Mission Directorate and NBL, challenges undergraduates to design, build and test a tool or device that addresses an authentic, current space-exploration problem.

Eight universities arrived at JSC on June 2 for Micro-g NExT's first pilot week. After spending the spring semester developing tools, the students finally got to put their imaginations—and technology—to the test. Each team representative commanded professional NBL divers straight from the Test Control Room to see how their devices operated underwater, a simulated microgravity environment. While at JSC, Micro-g NExT participants also celebrated the 50th anniversary of the first U.S. spacewalk by putting on a live webcast, sharing information about their findings and congratulating NASA on its milestone.

NASA/PHOTO JAMES BLAIR

NBL diver Lance Hansen (left) listens to University of Texas' Rory Fulton describe his tool before a test dive.

For many, this week was a turning point in both their academic and engineering careers. It not only helped clarify decisions to pursue STEM fields, but inspired future employees to contribute to the history of human space exploration.

The second group of students is set to arrive Aug. 2 for their turn in the NBL.

Testing technology on Earth to explore Mars in the future

While Micro-g NExT teams stayed poolside, from June 2 to 4 the sun shined on eight other university teams at JSC's rock yard for NASA's Fifth Annual Revolutionary Aerospace Systems Concepts–Academic Linkage (RASC-AL) Exploration Robo-Ops Competition. Robo-Ops is one of several RASC-AL collegiate design competitions sponsored by NASA and administered by the National Institute of Aerospace that exercise innovation in support of NASA's new approach for human space exploration.

During Robo-Ops, teams design, build and conduct field tests of rover prototypes on simulated planetary surfaces. The extravagantly engineered rovers had to negotiate specified up-and-down slopes, traverse sand and gravel pits, drive over large rocks and pick up and stow specific rock samples—all while being tele-operated remotely from "mini mission control centers" at their university campuses.

This year's competition was tied to expanding human presence in the solar system. Teams demonstrated Mars-forward capabilities to reduce mass and increase reliability in a deep-space environment, replicated crew-assisted sample return and validated tele-operated robotic asset work on lunar and Martian surfaces.

"These student are learning how to use robotic 'eyes' and algorithms to track and target various objects, just like we would in space," said program sponsor and NASA Langley Human Space Architecture Integration Manager Pat Troutman. "In the competition they get to demonstrate and understand what it means to strategize and adapt to the challenges of different planetary environments so that we can explore with affordability."

NASA/PHOTO BILL STAFFORD

Robo-Ops teams get out on JSC's rock yard to watch their rovers in action.

Competing teams included: University of Maryland (first place), West Virginia University (second place), University at Buffalo (third place), California State University-Long Beach, Massachusetts Institute of Technology, San Jose State University, Virginia Polytechnic Institute and State University and the University of Utah.

Enhancing the student STEM experience

JSC Education also kicked off its 16th year of Texas High School Aerospace Scholars (HAS). HAS is a two-part program with an online component to provide scholars with a foundation of knowledge about NASA and Mars exploration and an all-expenses-paid one-week workshop at JSC.

For six weeks in summertime, more than 200 Lone-Star high-schoolers will hear from JSC experts on diverse topics such as Apollo, the International Space Station one-year crew, Orion, Morpheus, Boeing's CST-100, the Modular Robotic Vehicle, Asteroid Redirect Mission and Mars architecture. They'll also gain engineering expertise while planning a fictitious Mars mission and building, launching and testing rockets, rovers and landers. New this year are engineering projects that call for students to design and build other hardware such as crew capsules, spacesuit helmets and gloves, sample-return vehicles and laboratories.

JSC's Education programs demonstrate NASA's desire to fully engage and teach students and educators and influence NASA's human spaceflight goals. These young innovators—who will one day be our STEM workforce—are dreaming up technologies today that, with time and maturation, could bring daunting intergalactic voyages off the drawing board and into flight.

NASA/PHOTO JAMES BLAIR

Texas high school juniors meet at JSC for a week full of learning and exploring.

Students get **technical with textiles**

By Anna Seils

COLLEGE STUDENTS from across the country packed into the Gilruth Center to present their innovative designs at the fourth annual Wearable Technology Symposium. Seven universities came together to share their projects, including schools as far as Alaska and Minnesota.

NASA/PHOTO LAUREN HARNETT JSC2015E052176

NASA engineer Elena Buhay tries on a mechanical counter-pressure glove designed and built for NASA's spacesuit team by University of Minnesota students.

The event was set up with 25 rapid-fire student presentations in the morning, with each team getting just five minutes to pitch their project. A poster session followed later in the afternoon. Many students received the opportunity to network with Johnson Space Center team members, who were invited to visit the poster session and inquire about the projects.

Cory Simon, Wearable Electronics Application and Research Lab manager at NASA, coordinated with professors to make sure all the students had a project and were prepared for the symposium.

"We have a very diverse group of minds here," said Simon. "An engineer can learn a lot looking at how a designer solves a problem."

Dr. Kam Lulla, director of the University Collaboration and Partnership Office within External Relations at JSC, was a vital player in laying the groundwork for the event. Five years ago, engineers from JSC were improving capabilities in developing wearable technology and wanted to leverage university expertise in design. Lulla helped coordinate with NASA's network of Space Grant Consortia to get resources and funding for the collaboration. The approach was interdisciplinary, as design students could work side by side with engineers on projects.

"This consortium is a grassroots consortium," Lulla said. "Someday we will be part of a larger story of the exploration of space."

The University of Minnesota was the first to collaborate four years ago, and the consortium has grown each year since. Simon gathered problem statements for wearable technology from JSC, and then paired mentors from JSC with students and teams.

"The field of wearable technology requires us to seek other perspectives," said Simon. Even, it would appear, perspectives from the "artsy" realm of fashion.

Dr. Lucy Dunne, associate professor at the University of Minnesota, encouraged her apparel design class students to demonstrate wearable technology from a design point of view. Dunne met Simon in 2012 and, with guidance from Lulla, pursued resources from the Minnesota Space Grant Consortium, which funds NASA-related educational opportunities in science, technology, engineering and math fields.

"It was a good vehicle to collaborate through the class," Dunne said. "The transition can be abrupt for some students. It is a back door into engineering."

This is a required class for all apparel design majors at Minnesota. Students Aly Gates and Catherine Menzel were ecstatic to take part in Dunne's class.

"This is the future of the fashion industry," Gates said. "This is making a scary amount of sense."

Menzel recited a quote that summed up the fashion industry in a nutshell: "There is nothing new in fashion—except the materials."

The idea behind the consortium is to expand and continue to collaborate with other schools across the country to develop new ideas for the interdisciplinary approach to wearable technology. By combining fashion and engineering, spaceflight apparel of the future will not only be well designed, but eminently functional.

NASA/PHOTO LAUREN HARNETT JSC2015E052190

Astronaut Mike Fossum tries on a wearable haptic navigation garment developed for NASA by a Georgia Tech student team.

Spotlight: **Leslie Hammond**

Robotics Flight Controller

Q: Coolest part of your job at Johnson Space Center?
A: Robotics! I have been involved in some part of the robotics operations for 20 years because it is so much fun. I started with space shuttle robotics, went to space shuttle robotics training, and now I'm in space station robotics. I enjoy putting together trajectories that are part of what tells the arm(s) where to go in their operating space. It's like solving an interesting puzzle. Probably the best part is controlling the Space Station Remote Manipulator System and/or Special Purpose Dexterous Manipulator in space, from the ground!

Q: June was Pride Month. As an ally with the Out & Allied Employee Resource Group, why do you think identifying as an ally is so important for the Lesbian, Gay, Bisexual, Transgender, Questioning, Intersexed or Allied (LGBTQIA) community?
A: Being an "out" ally lets those in the LGBTQIA community know that you are there as a safe person to talk to. They know that you are someone they can be themselves around, and that they needn't spend brainpower trying to hide some aspect of who they are. That makes for better communication, better teamwork and no time expended on anything but our awesome work in space. And, being an out ally isn't only a benefit to individuals who identify as LGBTQIA. Being visible as an ally can help straight co-workers feel more comfortable coming to you to ask questions about things they may not understand about some aspect of LGBTQIA culture or practices—greater understanding that hopefully results in greater acceptance.

Q: What is the most important quality an ally can possess?
A: Allies are probably most valuable when they speak up to stop the little comments and jokes they might hear from co-workers, family members and friends that are disrespectful toward or based on misinformation about LGBTQIA people. Finding kind ways to help educate fellow employees about LGBTQIA issues, and pointing out that it's not any more acceptable to make jokes at the expense of sexual minorities than it would be to poke fun at ethnic minorities is the first, best "grassroots" effort an ally can make to end discrimination on a larger scale. If you get accustomed to changing your attitudes and your languages when joking around with your friends, you will be less likely to say something that could be hurtful to others—and personally and professionally damaging to you—when you are around someone who is more impressionable (like a newer employee or your own children, or someone who may be LGBTQI themselves or have a family member who is).

Q: What would people be surprised to know about you?
A: Well, I'm not one to keep many secrets, so I'm not sure this is all that surprising … but I love cosplay. I have more costumes than any adult probably should. When going to the Renaissance Festival, I usually have enough leftover costuming to dress my friends, adult members of their families and female children, since I have made costumes for my girls since they were really little.

Q: If you could trade places with any other person for a week, famous or not famous, living or dead, real or fictional, who would it be?
A: This is a loaded question, because I read a lot of fantasy novels. I would want to be a character from Jim Butcher's "The Dresden Files"—one who knows Harry Dresden without being Harry himself, because he is always getting into very dangerous situations. I want to meet Harry, not

NASA /PHOTO JSC2010E022699

die in the horrible situations that he gets himself into. I guess I'd go with being Molly Carpenter. She's his apprentice, she knows a little bit of magic (which would be so cool), but she mostly stays out of the line of fire.

Q: What is your favorite indulgence?
A: Reading.

Q: What do you wish you could tell your younger self?
A: Follow your dream, not someone else's.

Q: What seemingly "little things" bring you joy?
A: Seeing my children learning to read and enjoying reading themselves.

Q: Describe yourself in three words.
A: Mom, flight controller, geek.

Q: When did you first become interested in space, and why?
A: I grew up in south Florida. I watched almost everything that launched from Kennedy Space Center go up. My father was a space buff, so he told me when to go see it. I can't ever remember not being interested in space. Space is the great adventure that I can have without leaving the comforts of home (or work), since I'm not actually strapping a rocket on to go out there myself. But I will happily hear all about it, and I'm happy to help those with that drive to get there … as long as they come back and tell me all about it.

Q: What is your favorite memory at JSC or of the space program?
A: I received a Silver Snoopy in 2002 for work I had done on STS-104 to revise some very old procedures that we used on the shuttle robotics system to jettison the robotic arm if it was unable to be stowed. I felt humbled and honored, and had some fun celebrating that achievement.

Q: What excites you most about NASA's #JourneyToMars?
A: Getting there, seeing if we can do it. Once we get there, because I believe we can do it, seeing what more we can learn by having more information than we are getting from the current rovers.

Ringing the bell

NEVER IN THE HISTORY of spaceflight has potential for economic growth been so widespread or space so accessible to American industry, researchers, innovators and explorers.

On June 4, NASA officials and U.S. commercial space partners rang the closing bell at the New York Stock Exchange. The "ringing of the bell" was made possible through Destination Station, an outreach campaign dedicated to educating the public about the benefits of space station research.

American companies are sending hundreds of experiments to orbit that will improve products and benefit our lives on Earth. Students are monitoring satellites of their own design while scientists are studying Earth right now, in real-time, from orbit. NASA astronauts are advancing the knowledge we need to send humans on our #JourneyToMars. It's a reality made possible by the International Space Station and the U.S. commercial space industry, opening the high frontier of space.

IMAGE CREDIT: NYSE

NASA—a more than 'suit'-able partner for the World Science Festival

NEW YORK CITY became the epicenter of an exciting science, technology, engineering, arts and math (STEAM) initiative they call World Science Festival from May 27 to 31. This was NASA and Johnson Space Center's second year participating. The festival focused on engaging young minds in STEAM through interactive sessions that not only taught and inspired, but were fun and creative.

As the festival led up to the 50th anniversary of the first American spacewalk, exhibits focused on engagement through the science, technology and careers represented by the spacesuit. In addition, the International Space Station Program offered insight into the vast array of science activities being conducted daily that directly benefit life on Earth. There were a number of additional activities offered by NASA, including the music our satellites make in space at the Orbit Pavilion and stargazing opportunities at Brooklyn Bridge Park with a phenomenal backdrop of the Hubble Space Telescope's greatest hits.

JSC rounded out its participation with astronaut engagement opportunities, including a stimulating experience for kids to don a spacesuit and be tethered and float, just as if they were on a spacewalk, with the help of our astronauts. If that wasn't enough, JSC team members gave visitors the chance to touch and manipulate actual spacesuit hardware, try maintenance tasks and demonstrated how loss of pressure can have serious outcomes without the protection of the suit.

During the World Science Festival, NASA potentially reached more than 250,000 visitors across all events and days.

NASA/PHOTO

NASA astronaut Nicole Stott interacts with the next generation of potential explorers.

Flames of glory

THE SOYUZ TMA-15M spacecraft is seen as it lands with Expedition 43 commander Terry Virts of NASA, cosmonaut Anton Shkaplerov of the Russian Federal Space Agency (Roscosmos) and Italian astronaut Samantha Cristoforetti from European Space Agency (ESA) near the town of Zhezkazgan, Kazakhstan, on June 11. Virts, Shkaplerov and Cristoforetti returned to Earth after more than six months aboard the International Space Station, where they served as members of the Expedition 42 and 43 crews.

NASA/BILL INGALLS

Roundup

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Orbital debris specialists gather in Houston for 33rd annual IADC meeting

THIS YEAR, NASA hosted the 33rd annual meeting of the Inter-Agency Space Debris Coordination Committee (IADC) in Houston during the week of March 30. Almost 150 orbital debris specialists from around the world attended. The Texas A&M Mays Business School at CityCentre provided session rooms for the four working groups and steering group.

During the opening session, JSC Deputy Director Kirk Shireman and JSC Chief Scientist Dr. Eileen Stansbery welcomed the delegates to Houston. Houston Mayor Annise Parker proclaimed the week of March 30 to April 2 as the "Inter-Agency Space Debris Coordination Committee Week" in Houston.

The IADC is an international governmental forum for the worldwide coordination of activities related to the issues of human-made and natural debris in space. Each year, IADC member agencies meet to exchange information on space debris research activities; to facilitate opportunities for cooperation in space debris research and review ongoing cooperative activities; and to identify debris-mitigation options. Member space agencies, now 13 as of 2015, rotate hosting the annual meetings.

The IADC is the internationally recognized technical authority on space debris. It was established in 1993 with four founding members: NASA, Roscosmos (the Russian Federal Space Agency), ESA (European Space Agency) and the Japan Aerospace Exploration Agency. In 2002, the IADC issued the first comprehensive international set of space debris-mitigation guidelines, which became the foundation of the United Nations Space Debris Mitigation Guidelines. These were endorsed by the U.N. General Assembly in 2007.

NASA /PHOTO JSC2015E046906

From left, head of the NASA delegation and NASA Chief Scientist of Orbital Debris Dr. J.-C. Liou and Mia Monroe, local organizing committee co-chair, with the mayor's proclamation.

NASA /PHOTO JSC2015E046990

Lisa Pace, local organizing committee chair, with Jeffrey Jones, Texas A&M facility manager, at the 33rd annual IADC meeting in Houston.