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National Aeronautics and
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KENNEDY SPACE CENTER'S

SPACEPORT magazine

Growing Up Gator

Hatchling research offers environmental clues

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KENNEDY SPACE CENTER'S

SPACEPORT MAGAZINE

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Front Cover: NASA's plant experiment, called Veg-01, provides fresh food grown in the microgravity environment of space officially is on the menu for the first time for NASA astronauts on the International Space Station. On the cover is red romaine lettuce. Photo credit: NASA

Back Cover: Baby alligators are held before being returned to their mother inside a laboratory at Kennedy Space Center. Throughout the summer, as the tiny reptiles developed in their eggs, they were unwitting but active participants in an ongoing study of alligator nests at Kennedy. Photo credit: Kim Shiflett

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NASA'S LAUNCH SCHEDULE

Date: Sept. 2, 12:34 a.m. EDT
Mission: Expedition 45 Launch to the space station
Description: Expedition 45/46 crew member Sergey Volkov of Roscosmos will launch on a Soyuz 44 taxi flight with ESA astronaut Andreas Mogensen. Mogensen will return to Earth with Soyuz Commander Gennady Padalka in the Soyuz 42 spacecraft in 10 days. http://go.nasa.gov/1BspAy1

Date: Oct. 21
Mission: Progress 61P Cargo Craft
Description: The Progress resupply vehicle is an automated, unpiloted version of the Soyuz spacecraft that is used to bring supplies and fuel to the space station.

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

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

I am KENNEDY SPACE CENTER

GRIFFIN LUNN

I am a chemical engineer on the Engineering Services Contract, working for Stinger Ghaffarian Technologies. I split my time between chemical and biological sciences and the fluids offices, supporting world-class scientists and engineers in achieving sustained human habitation beyond low-Earth orbit.

My primary task is to support and sometimes lead research efforts for Environmental Control and Life Support Systems and In-Situ Resource Utilization activities. This involves designing, constructing, testing and evaluating novel bioreactors for waste water and other treatments which we hope to commercialize in the future. Other projects include traditional thermobaric reactors, plant systems, and novel separation processes (removing a valuable chemical stream from a less valuable one). If proposing your own ideas for competitive grants (and sometimes winning and trying to prove it) isn't the best job ever, I don't know what is.

In addition, I support the design and construction of ground support equipment for the Space Launch System, with a focus on certification of the pressure vessel systems. My tasks include automation of this process and improving efficiency and accuracy so we can meet tight schedules and changing requirements. It is an honor to work on the most capable launch vehicle humanity has ever witnessed.

We are going to make it to Mars in my lifetime. I'm going to make sure we can stay there.

Meals Ready to Eat

Expedition 44 crew members sample leafy greens grown on space station

BY LINDA HERRIDGE

Fresh food grown in the microgravity environment of space officially is on the menu for the first time for NASA astronauts on the International Space Station. Expedition 44 crew members, including NASA's one-year astronaut Scott Kelly and Kjell Lindgren sampled the fruits of their labor after harvesting a crop of "Outredgeous" red romaine lettuce Monday, Aug. 10, from the Veggie plant growth system on the nation's orbiting laboratory.

The astronauts cleaned the leafy greens with citric acid-based, food safe sanitizing wipes before consuming them. They ate about half of the space bounty, setting aside the other half to be packaged and frozen on the station until it can be returned to Earth for scientific analysis.

"If we're ever going to go to Mars someday, we're going to have to have a spacecraft that is much more self-sustainable with regards to its food supply, as well as other things. On the way to Mars and on the way back we're not going to be able to get resupplied," Kelly said. "There's going to be a long period of time where we're going to have to be completely self-sufficient. This payload and having the ability for us to grow our own food is a big step in that direction."

NASA's plant experiment, called Veg-01, is being used to study the in-orbit function and performance of the plant growth facility and its rooting "pillows," which contain the seeds.

NASA is maturing Veggie technology aboard the space station to provide future pioneers with a sustainable food supplement — a critical part of NASA's Journey to Mars. As NASA moves toward long-duration exploration missions farther into the solar system, Veggie will be a resource for crew food growth and consumption. It also could be used by astronauts for recreational gardening activities during long-duration space missions.

The first pillows were activated, watered and cared for by Expedition 39 flight

engineer Steve Swanson in May 2014. After 33 days of growth, the plants were harvested and returned to Earth in October 2014. At Kennedy Space Center, the plants underwent food safety analysis. The second Veg-01 plant pillows were activated by Kelly on July 8 and grew again for 33 days before being harvested. The seeds had been on the station for 15 months before being activated.

LED lights to grow plants was an idea that originated with NASA as far back as the late 1990s, according to Dr. Ray Wheeler, lead for Advanced Life Support activities in the Exploration Research and Technology Programs Office at Kennedy.

Wheeler worked with engineers and collaborators to help develop the Veggie unit from a Small Business Innovative Research project with ORBITEC. Dr. Gioia Massa

growth," Wheeler said. "They are probably the most efficient in terms of electrical power conversion. The green LEDs help to enhance the human visual perception of the plants, but they don't put out as much light as the reds and blues."

Wheeler, Massa and Dr. Gary Stutte, all from Kennedy, previously investigated similar experiments to grow plants in the Habitat Demonstration Unit at NASA's

Opposite: Kjell Lindgren and Scott Kelly sample the red romaine lettuce which was grown as part of the Veggie experiment after it spent 33 days growing aboard the station. Photo credit: NASA

The red romaine lettuce growing aboard the International Space Station. Photo credit: NASA

The Veggie system was developed by Orbital Technologies Corp. (ORBITEC) in Madison, Wisconsin, and tested at Kennedy before flight. Veggie, along with two sets of pillows containing the romaine seeds and one set of zinnias, was delivered to the station on the third cargo resupply mission by SpaceX in April 2014.

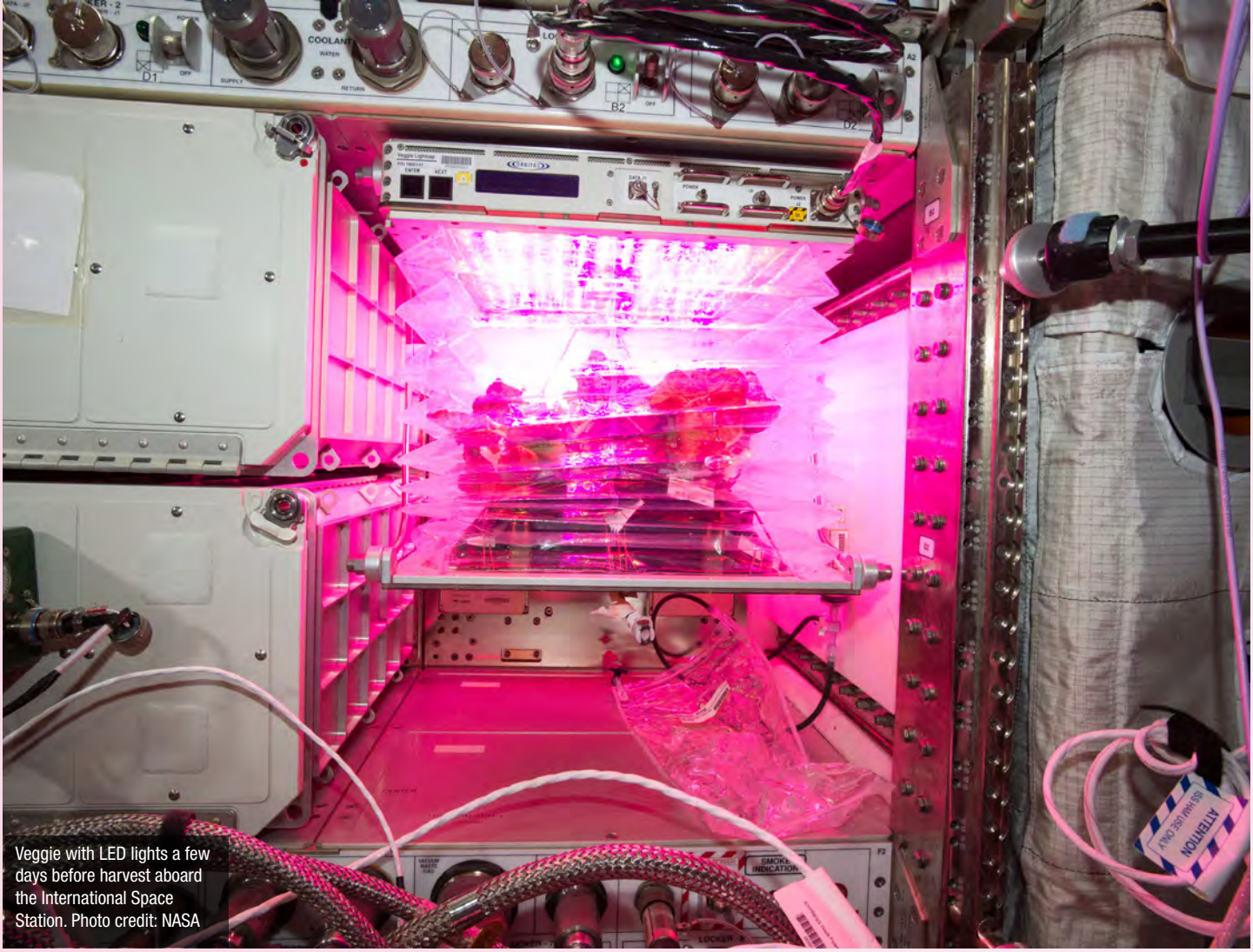
The collapsible and expandable Veggie unit features a flat panel light bank that includes red, blue and green LEDs for plant growth and crew observation. Using

is the NASA payload scientist for Veggie at Kennedy. Massa and others worked to get the flight unit developed and certified for use on the space station. The purple/pinkish hue surrounding the plants in Veggie is the result of a combination of the red and blue lights which, by design, emit more light than the green LEDs. Green LEDS were added so the plants look like edible food rather than weird purple plants.

"Blue and red wavelengths are the minimum needed to get good plant

desert test site near Flagstaff, Arizona, in 2010 and 2011. Wheeler said Veggie will help NASA learn more about growing plants in controlled environment agriculture settings. Similar settings include vertical agriculture, which refers to stacking up shelves of plants that are grown hydroponically and then using electric light sources like red and blue LEDs. This kind of system is popular in some Asian countries and beginning to grow in the U.S.

"There is evidence that supports fresh



Veggie with LED lights a few days before harvest aboard the International Space Station. Photo credit: NASA

foods, such as tomatoes, blueberries and red lettuce are a good source of antioxidants. Having fresh food like these available in space could have a positive impact on people's moods and also could provide some protection against radiation in space," Wheeler said.

After the first crop of lettuce was returned from the space station, Massa began working with a team of flight doctors and NASA safety representatives to get approval for the crew to eat the produce.

"Microbiological food safety analysis looks very good on the first Veg-01 crop of romaine lettuce," Massa said.

Besides the nutritional benefits, could growing fresh produce in space also provide a psychological benefit? Alexandra Whitmire, a scientist at NASA's Johnson Space Center in Houston is involved in research to answer that question.

Whitmire is a Behavioral Health and Performance Research scientist for NASA's Human Research Program. Her team supports research related to reducing psychological risks on a Mars mission.

> ***"The farther and longer humans go away from Earth, the greater the need to be able to grow plants for food, atmosphere recycling and psychological benefits. I think that plant systems will become important components of any long-duration exploration scenario."***
>
> **– Dr. Gioia Massa**
> **NASA payload scientist**

"The Veggie experiment is currently the only experiment we are supporting which involves evaluating the effects of plant life on humans in space," Whitmire said.

Her team is focused on crew behavioral conditions, performance reduction, and team communication and psychosocial adaption.

"Future spaceflight missions could involve four to six crew members living in a confined space for an extended period of time, with limited communication," Whitmire said. "We recognize it will be important to provide training that will be effective and equip the crew with adequate countermeasures during their mission."

The countermeasures could include things like meaningful work. Habitat-related modifications also could include plant life. Whitmire said Earth studies have shown plants are associated with well-being and optimal performance. Plants potentially could serve as a countermeasure for long-duration exploration missions.

"I think that there's a benefit to getting fresh food we grow up here and the kind of contributions that vegetables like this

The red romaine lettuce growing aboard the International Space Station. Photo credit: NASA

have to our small ecosystem," Lindgren said. "The space station is kind of a sterile environment, and it's really fun to see green growing things here for sustenance. We appreciate this payload."

Massa agrees.

"Besides having the ability to grow and eat fresh food in space, there also may be a psychological benefit." Massa said. "The crew does get some fresh fruits or vegetables, such as carrots or apples, when a supply ship arrives at the space station. But the quantity is limited and must be consumed quickly."

Having something green and growing — a little piece of Earth — to take care of when living and working in an extreme and stressful environment could have tremendous value and impact.

"The farther and longer humans go away from Earth, the greater the need to be able to grow plants for food, atmosphere recycling and psychological benefits. I think that plant systems will become important components of any long-duration exploration scenario," Massa said.

The system also may have implications for improving growth and biomass production on Earth, thus benefiting the average citizen. Massa said many of the lessons NASA is learning with Veggie could be applied in urban plant factories and other agriculture settings where light is provided by electrical light and water conservation is practiced.

"We hope to increase the amount and type of crop in the future, and this will allow us to learn more about growing plants in microgravity," Massa said. "We have upcoming experiments that will look at the impacts of light quality on crop yield, nutrition and flavor, both on Earth and in space."

The team at Kennedy and Johnson hope that Veggie and space gardening will become a valued feature of life aboard the space station and in the future on Mars.

The International Space Station travels at 17,

#YearInSpace

500mph and orbits Earth every 90 minutes.

www.nasa.gov/oneyear

A baby alligator works its head free of its egg as it hatches inside a laboratory at Kennedy Space Center. Kennedy's Ecological Program studies several facets of alligator health, including nesting. The center shares a boundary with the Merritt Island National Wildlife Refuge, which encompasses 140,000 acres that provide a habitat for more than 330 species of birds, 31 mammals, 117 fishes, and 65 amphibians and reptiles. Photo credit: NASA/Kim Shiflett

SWAMP SURVIVAL

Alligators born at spaceport offer insight into environmental, human health

BY ANNA HEINEY

Young Luke and Leia are facing an uphill struggle for survival. The odds are against them.

The siblings aren't lightsaber-wielding rebels, and their enemies have nothing to do with a power-hungry empire. Luke and Leia are newly hatched American alligators. Their top priority in the next few years is avoiding deadly encounters with the wild hogs, raccoons, larger gators and other predators in the wilderness around Kennedy Space Center.

Luke and Leia hatched Aug. 21 within the safe confines of an incubator near the spaceport's famous launch complex. Throughout the summer, as the tiny reptiles developed in their eggs, they were unwitting but active participants in an ongoing study of alligator nests at Kennedy.

"It boils down to this: Genetically, humans, alligators and other animals have many similarities," explained Lynne Phillips, a NASA physical scientist in Kennedy's Environmental Management branch. She oversees Kennedy's Ecological Program, which manages several wildlife research programs at the spaceport, including alligator studies.

"Our endocrine systems are nearly identical. If there is an impact to alligators' endocrine system, we can relate it directly to human health."

Alligators are "apex predators," meaning they're at the top of the food chain at Kennedy. This makes them one of the proverbial canaries in the environmental coalmine here in central Florida. Researchers study alligators at Kennedy and across the sunshine state because at each stage of life, the animals provide vital clues about the health of the local ecosystem and shed light on the physiological effects of an unhealthy environment.

Luke and Leia are just two out of several nests of baby alligators hatched in 2015. They served as this season's sentinels.

Kennedy Space Center is well-known as the nation's flagship launch site, a starting point for missions of discovery and a testbed for new technologies. But the spaceport also shares boundaries with the 140,000-acre Merritt Island National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service. And while the refuge's diverse array of ecosystems provide sanctuary for hundreds of species, it offers biologists an ideal location to monitor how our planet is changing and learn how these changes impact those who live in it.

There are national requirements for protecting the environment and endangered species, including the National Environmental Policy Act and Endangered Species Act. But Kennedy's wildlife studies are about more than that, Phillips said.

"NASA has its own self-imposed sustainability and environmental requirements. We are very invested in sustaining our environment here on Earth," she explained. "We want to be leaders in environmental stewardship."

Kennedy's Ecological Program began studying alligators in 2006. The spaceport's unique location and isolated alligator population provided a good reference site for alligator studies already underway in Florida. The program was set up with the help of Dr. Louis Guillette, a world-renowned biologist with the Medical University of South Carolina in Charleston. Guillette, a co-investigator, contributed time and expertise in studying the impacts of environmental contamination on wildlife and regularly collaborated with the Kennedy team until his death Aug. 6, 2015.

The research is a collaborative effort. The Ecological Program partners with the U.S. Fish and Wildlife Service, Florida Fish and Wildlife Conservation Commission, the Medical University of South Carolina and the South Carolina Department of Natural

Alligator eggs are marked “Luke” and “Leia” during their incubation inside a laboratory at Kennedy Space Center. Photo credit: Cory Huston

Resources, but there also are contributing team members across the U.S., as well as Central America, Africa and Japan.

ALLIGATORS PROVIDE CLUES ABOUT ENVIRONMENTAL HEALTH

Endocrine disrupting contaminants such as organic compounds and heavy metals can have a dramatic effect on the fertility and reproductive development of the population. Research has shown that adult male alligators in contaminated surroundings have significantly higher levels of contaminants in their bodies than adult females — because the contaminants in females are offloaded into their eggs.

But what does that do to the developing embryos, and ultimately, the alligator population as a whole? And what about the effects of rising temperatures with climate change? Incubation temperatures determine whether babies develop into males or females.

Monitoring the development and hatch rates of gator embryos and tracking temperatures at nests across the refuge will help find answers to these questions, according to Stephanie Weiss and Russ Lowers, wildlife biologists with InoMedic Health Applications, or IHA, at Kennedy.

"The nesting research tells us the reproductive health of the population here," Weiss said.

This season alone, the team collected 352 eggs for the study, and many are still in the process of hatching out. More than 2,600 eggs have been collected since the program's inception, with an overall hatch rate of 77 percent.

"Studying large animals will give you the toxicology results dating farther back," Lowers added. With the nesting research, he pointed out, "we're going back to where they start, as eggs."

No one knows how many alligators call the refuge home. But for about two weeks at the end of every June, adult females get to work building nests out of marsh grasses, cattails or other nearby materials in order to launch a new generation of gators.

NESTING SEASON BEGINS

Temperatures hovered around 90 degrees Fahrenheit as the sun rose on June 24. Despite the sweltering heat and humidity, the research team headed out in pickup trucks to a freshwater marsh about a mile and a half northwest of the spaceport's Vehicle Assembly Building.

Nesting gators build their nests in hard-to-reach places, but team members knew where they were going. They'd spotted the nest during a survey flight aboard a NASA helicopter.

"The helicopter is the number one most important tool in our tool chest for finding alligator eggs," Lowers

said. “These moms tend to put their nests far away from public access.”

Adult females at Kennedy reproduce every three years or so, laying a clutch of 30 to 40 eggs in late June. Researchers hope to find 20 nests per season, Weiss said, but it varies from year to year.

“Typically, we don’t find that many nests out here,” she explained, “but this was a good year.”

Biologists have to trek through marsh grass and muck to reach the nest. The mother alligator usually isn’t home when the team shows up. Nine times out of 10, she’s out and about, only checking her nest periodically. But sometimes, she’s right there.

“If Mom is there, you have somebody watch her, but she’s usually pretty docile. She’ll hiss at you, but she’ll usually stay back,” Lowers said.

“If she doesn’t want you anywhere near there, she tells you. And in that case, we’ll capture her and pull her to the side. We put her in a little timeout for a minute, and then let her go.”

The first 10 nests were outfitted with tiny, wireless sensors, called thermistors, which are programmed to log the current temperature every five minutes throughout the nesting cycle, typically about 60 days. Temperatures above 31.5 degrees Celsius (about 89 degrees Fahrenheit) result in more males; temperatures below that level produce more females. Biologists want to track these temperatures year after year in order to watch for trends and monitor the balance of males to females. This data is compiled at the end of the season, after the nest is hatched out and the sensors can be collected.

Only one team member approaches these nests, first covering up with water and mud in an effort to prevent area predators from associating humans’ scent with the presence of eggs. Thermistors are carefully inserted in the nest beside the egg cavity at three different depths — the bottom, middle and top — as well as in a nearby tree. Most of the eggs are left in place; a few are collected and brought back to the laboratory.

At other nests, all eggs were removed. Such was the case for Luke and Leia. Their mother helpfully had constructed her nest at the base of a tree just a few steps from a dirt road.

The team used a thermistor to check the temperature inside the nest, then measured its width and height, as well as the depth of the egg cavity inside. Finally, they pulled the eggs out one by one, drawing a line on the top of each to mark its orientation — a rudimentary “This Side Up.”

“When we pull an egg out, we can’t tilt it, turn it or shake it. If we do, we’ll kill that egg,” Lowers explained.

The eggs were carefully placed in a bin lined with nest materials. Then they, too, were driven to the lab.

Several newly hatched alligators try to get a better view over the side of their nesting container inside a laboratory at Kennedy Space Center. A few of its newly hatched siblings look on. Kennedy's Ecological Program studies several facets of alligator health, including nesting. Photo credit: NASA/Dimitrios Gerondidakis

INTO THE INCUBATOR

Luke and Leia finally got their names when they arrived at "the shed," a facility that includes the Ecological Program's wildlife laboratory. Lowers and Weiss shined a bright light into one end of each egg, a process called "candling." Viable eggs revealed a dark-banded center.

One egg from every nest — including the eggs removed from the thermistor nests — was opened up in order to determine the gestational age of the embryo, which in turn told the researchers when the eggs were deposited and roughly when they would hatch.

Each clutch was placed into a bin lined with sterile sphagnum moss to cradle the eggs and keep them moist. Then the bins went into the incubator, set to a steady 31.5 degrees Celsius.

And then the biologists waited and watched for nearly two months.

On Aug. 21, Luke and Leia made their debut, chirping loudly as they pushed their way out of their shells.

Their siblings began to pop out one by one, encouraged by the noises of the hatchlings around them. It can take up to a week for a clutch to completely hatch out.

Of the 33 eggs collected from that nest, 24 hatched.

"They come out very feisty, too," Weiss said. "They bite onto each other and start rolling."

The last of Luke and Leia's siblings emerged on Aug. 26. At barely 10 inches long, the babies were ready to start their lives in the wild.

REPTILIAN REUNION

Two days later, Lowers loaded the newly hatched gators from Luke and Leia's nest into a shallow container with just a little water. He carried the lidded bin outside to a waiting pickup truck.

It was the alligators' first time seeing sunlight or smelling outdoor air.

A little more than two months had passed since Phillips, Lowers and Weiss first had visited the nest to collect the eggs. Lowers took the lid off the bin and tipped it, gently emptying the babies onto the soft grass atop the nest.

Their mother was nowhere in sight, but they called out for her, several of them making their way down the side of the nest toward the water a few feet away.

"Mom will hear them and come greet them just as she would if they had hatched out of the nest," Lowers said.

"Alligators are kind of unique with the maternal instincts they have," Weiss said. "They will defend the nest, and they will defend the babies for a year or two. In the reptile world, that is unusual."

Even with the guidance of an attentive mother, less than one percent of baby alligators make it through their first four years.

This means Luke and Leia have their work — to reach adulthood — cut out for them. But one glance across almost any body of water at the spaceport reveals multiple grown gators, their spiny backs barely breaking the surface as they slowly cruise around.

Clearly, even with the odds stacked against them, many little ones manage to survive. The Force is strong in them.

Baby alligators experience the wild for the first time in the minutes following their release onto the nest where they were first collected as eggs. The reptiles hatched in captivity inside an incubator at Kennedy Space Center. Photo credit: NASA/ Frankie Martin

Mid-June – Mother gator builds a nest and lays her eggs

June 24 – Eggs collected and brought to laboratory for incubation

Aug. 21 – Luke and Leia hatch

Aug. 28 – Baby gators returned to nest

Watch alligator hatchings and their release into the wild:
https://youtu.be/kXqNx00E5qQ

Somber procession delivers piece of American history to Kennedy

A section of I-beam that once strengthened the World Trade Center in New York has made its way to Kennedy Space Center, where it will serve as a memorial to the 343 fire/rescue personnel who gave their lives to save others on Sept. 11, 2001.

Kennedy Space Center Fire Department officials traveled to New York to escort the artifact to Florida. Weighing in at about one ton, the 7-foot-long, 16-by-16-inch steel beam was flown from New York to Miami in a specially built wooden container manufactured by American Airlines.

The beam is slated to become the centerpiece of a permanent memorial at Fire Station No. 1, located in the heart of Kennedy Space Center's industrial complex. The memorial features scaled replicas of the World Trade Center's twin towers, which will be topped by the newly arrived beam. A formal dedication is planned for Sept. 11.

Photo credit: NASA/Dimitri Gerondidakis


NOT ONLY TEARS OF SORROW
BUT ALSO THOSE
OF PRIDE
KSC
343
FIRE
DEDICATED ON SEPTEMBER 11, 2012
IN HONOR OF OUR FALLEN HEROES
STOP
NASA
FIRE RESCUE
SERVICES
Sky-Arm

LiFi

Light technology being developed for advanced communications

BY BOB GRANATH

Kennedy Space Center recently entered into a partnership with Light Visually Transceiving, or LVX, System Corp. to collaborate in developing a potentially ground-breaking technology in electronic communications. Similar to high-speed communication known as Wi-Fi, visible light communication, or VLC, is a wireless method using light-emitting diodes, or LEDs, referred to as Li-Fi.

Using standard room lighting, VLC transmits data using LEDs to send wireless communications signals. It can be used as a standalone technology or as a supplement to radio-frequency or cellular networks. Ultimately, the innovation has potential applications for use in everything from a local coffee shop to a spacecraft on its way to Mars.

According to principal investigator Eirik Holbert, Ph.D., VLC is a very basic concept.

"The technology simply provides a wireless network using light instead of radio signals and copper wires to transmit data," he said.

On July 30, 2015, Kennedy Director Bob Cabana signed a Space Act agreement with LVX Board Chairman and CEO John Pederson to license researchers at Kennedy to study and develop new applications for visual light communication.

Space Act Agreements are legal understandings empowering NASA to work with any organization that helps fulfill the agency's mandate. This effort, coordinated by Center Planning and Development at Kennedy, is a continuation of the center's transition to

NASA research physicist Eirik Holbert, Ph.D., examines a prototype light fixture capable of providing a potentially ground-breaking wireless communication technology known as visible light communication, or VLC. Similar to the high-speed communication known as Wi-Fi, this concept called Li-Fi has shown that it can provide virtually unlimited data transfer and operates with considerably less energy requirements. Photo credit: NASA/Kim Shiflett

a diverse, multi-user spaceport.

NASA and LVX are studying enhancements to lighting system capabilities in hopes of improving the technology and adding features such as Global Positioning Satellite Routing Systems architecture. While the International Space Station already has a Wi-Fi system, Holbert says a Li-Fi network may be a possibility for a spacecraft making the first trip to the Red Planet.

"A future manned spacecraft making a trip to Mars could be a candidate for this kind of communications system," he said. "Also, a deep-space habitat operating on the surface of the planet could use VLC."

Deep Space Habitat is a proposed NASA conceptual design to support a crew exploring beyond low-Earth orbit. It would allow astronauts to live and work safely for up to a year or more on missions to near-Earth asteroids, the vicinity of the moon, or on the surface of Mars.

Innovations such as VLC and Li-Fi are additional ways NASA is investing in the future. The agency continually seeks technology solutions that dramatically improve its capabilities while generating tangible benefits.

Light communication is not new. Its history goes back as far as the 1880s when Alexander Graham Bell, inventor of the telephone, developed the photophone. In a demonstration in Washington, D.C. he transmitted speech using modulated sunlight over a distance of several hundred yards. This experiment even pre-dates the first transmission of speech by radio.

"The possibility of using this technology has been around for a long time," said Holbert, a research physicist at Kennedy's Swamp Works. "Until recently, no one considered the advantages worthwhile. Advances in electronics have made this more practical."

Swamp Works was established at KSC to provide rapid, innovative and cost-effective solutions to the challenges posed by NASA's plans for exploration. The scientists and engineers working there do this by leveraging partnerships across the agency, industry and academia. Concepts start small and build up fast, with lean development processes and a hands-on approach.

Over the past few years, researchers found that a "fiberless" light photon medium has shown that it can provide virtually unlimited data transfer and operate with considerably less energy requirements, thus making it a "green" technology.

> ***"A future manned spacecraft making a trip to Mars could be a candidate for this kind of communications system."***
>
> **– Dr. Eirik Holbert**
> **Principal Investigator**

While Internet transmissions via radio-frequency bandwidths are limited, the visible light spectrum is 10,000 times larger. By comparison, this makes the VLC data capacity almost infinite.

VLC also presents significantly reduced security risks.

"My biggest concern with using Wi-Fi in a restaurant, hotel or on an airplane is the possibly of 'sharing' my credit card information," Holbert said. "Internet traffic transmitted by radio frequency signals are always vulnerable."

Holbert explains that a building or facility equipped with LED light fixtures could be set up to use VLC technology.

"The prototype light fixtures we've developed are primarily made with readily available off-the-shelf hardware," he said. "We've been able to build simple prototype receiver hardware from $5 worth of parts."

The challenge is finding a way to make the network work in a way that is economically feasible.

It can connect to the actual internet through any usual manner. LEDs in lighting fixtures communicate by flashing or blinking in a manner that is so fast it is undiscernible to the human eye.

To use the LED network, a user simply needs a small receiver/transmitter device to connect to a laptop computer or cellular telephone using a USB (universal serial bus) port.

With LVX now headquartered at Kennedy, the Space Act Agreement will facilitate the work of their researchers and NASA experts, such as Holbert, in developing new lighting technologies and applications for VLC. This will not only focus on the development of Li-Fi for use on future deep-space missions, but include innovations that have the potential to benefit daily life.

During the five-year Space Act Agreement between NASA and LVX, Kennedy will perform reimbursable services to further research and technology development of VLC and lighting system expansion. Working in Kennedy's Swamp Works, scientists and engineers will provide a final prototype at the conclusion of the agreement consisting of a camera, microphone and speaker technologies.

Holbert explains that VLC does have its limitations. Unlike Wi-Fi, Li-Fi must be used where lighting is available. By using radio frequency signals, Wi-Fi can, for example, penetrate walls.

"Li-Fi will likely never completely replace Wi-Fi," he said. "But it does have potential. If we can make it worthwhile, it could become a very valuable technology down the road for space travel."

MAJOR MODS

Mobile Launcher upgrades will support NASA's next-generation rocket, spacecraft

BY LINDA HERRIDGE

The mobile launcher, or ML, that will support NASA's Space Launch System, or SLS, and Orion spacecraft for Exploration Mission-1 is in view at the Mobile Launcher Park Site at Kennedy Space Center. The ML base and tower structure were modified to accommodate the weight, size and thrust at launch of the SLS and Orion spacecraft. Photo credit: NASA/Cory Huston

Mars

NASA's mobile launcher, or ML, is shaping up nicely as modifications continue on the ground structure that will launch the agency's Space Launch System rocket and Orion spacecraft on the journey to Mars and other deep-space destinations.

"We just finished up a major construction phase of the mobile launcher," said Eric Ernst, NASA ML project manager. "We were actually able to accelerate some of the work."

NASA recently selected J.P. Donovan Construction Inc. of Rockledge, Florida, to begin the next phase of work on the 380-foot-tall (including the base), 10.5-million-pound steel structure at Kennedy Space Center.

J.P. Donovan Construction will install and integrate ground support equipment, or GSE, systems onto the mobile launcher to modify the structure with the systems necessary to assemble, process and launch NASA's integrated Space Launch System rocket and Orion spacecraft. The scope of work includes the installation of mechanical, electrical and fluid subsystems that will support the SLS rocket.

According to Ernst, this phase will include the installation of more than 800 mechanical, fluid and electrical panels, about 300,000-plus feet of cabling, and miles of tubing and piping.

"One of our big challenges is that SLS, Orion and GSE systems are all in development concurrently," Ernst said. "Now we are working to develop an install design for the hardware. There are a lot of unique challenges."

Members of the media recently toured the ML and saw first-hand all of the upgrades and modifications that have been completed so far. The ML was originally developed to support Ares I. The base and tower structure were modified to accommodate the much larger SLS/Orion configurations. These modifications included structural reinforcement of the base and tower and increased exhaust hole to accommodate the much larger launch vehicle.

"To increase the size of the exhaust hole and strengthen the base, we had demolition of more than 750 tons of steel, and fabrication and installation of more than 1,000 tons of new steel," said Mike Taylor, project manager for J.P. Donovan.

A series of lines will connect the ML to various parts of the rocket to provide the necessary power, fuel, and communications until launch. These umbilical lines release at liftoff and then retract to clear the way for the rocket. The base of the ML will contain the tail service mast umbilicals. The tower will contain several umbilicals, including the crew access arm, the Orion service module umbilical, and several umbilicals that will provide power, cryogenics and stability to the SLS rocket.

The ML is planned to be rolled to the Vehicle Assembly Building in early 2017.

Overseeing modification to the ML is one of many ways the Ground Systems Development and Operations Program is helping to prepare Kennedy to process and launch the next-generation vehicles and spacecraft designed to achieve NASA's goals for space exploration. To achieve this transformation, the NASA and contractor workforce is developing the necessary ground systems while refurbishing and upgrading infrastructure and facilities to accommodate government, commercial and other customers' needs.

Eric Ernst, NASA Mobile Launcher project manager, talks to members of the media beneath the mobile launcher, or ML, at the Mobile Launcher Park Site at Kennedy Space Center. A contract recently was awarded to J.P. Donovan Construction Inc. of Rockledge, Florida, to begin the next phase of work on the 380-foot-tall (including the base) steel structure. The scope of work includes the installation of mechanical, electrical and fluid subsystems, including 800 mechanical, fluid and electrical panels, about 300,000-plus feet of cabling, and miles of tubing and piping. Photo credit: NASA/Cory Huston

National Aeronautics and
Space Administration

FACES OF GSDO

GROUND SYSTEMS DEVELOPMENT & OPERATIONS

Karen Curry

Executive Assistant, Wichita Tribal Enterprises

KENNEDY SPACE CENTER

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SP-2015-08-325-KSC

KSC Scenes

Inside the Launch Abort System Facility at Kennedy Space Center, workers prepare the Orion spacecraft that flew on Exploration Flight Test-1 in 2014 for transport to Orion prime contractor Lockheed Martin's facility in Denver, where it will undergo direct field acoustic testing. This is a technique used for acoustic testing of aerospace structures by subjecting them to sound waves created by an array of acoustic drivers. For the test, several electro-dynamic speakers will be arranged around Orion to provide a uniform, well-controlled, direct sound field test at the surface of the spacecraft. Orion will next launch atop NASA's Space Launch System rocket on Exploration Mission-1.

Photo credit: NASA/Amber Watson

UNDER PRESSURE

COPV training important to safety and mission assurance

BY FRANK OCHOA-GONZALES

The remains of a test composite overwrapped pressure vessel, or COPV, after it bursts. Photo credit: NASA/WSTF

Technology

On Dec. 23, 2008, a composite overwrapped pressure vessel burst catastrophically during testing at Kennedy Space Center's Cryogenics Laboratory while it was being pressurized with liquid and gaseous nitrogen or LN2/GN2. The resulting boiling liquid expanding vapor explosion, or BLEVE, knocked down the protective barriers and caused LN2/GN2 to flow into the area where 11 members of the test team were monitoring the test.

Four team members were injured with cryo burns and cracked ribs. Although there were no fatalities associated with this mishap, there was a significant risk of asphyxiation due to the quantity of GN2 that entered the lab's high bay.

The mishap investigation report found that no blast/fragmentation or quantity distance siting analysis was performed before the pressure testing. It also was discovered that blast/fragmentation analysis training was not available within NASA to calculate the type of standoff distances and fragmentation protection needed to ensure personnel safety and facility protection.

In order to prevent further accidents of this type, the mishap report recommended that NASA develop pressure vessel blast wave and fragmentation effect and BLEVE analysis training utilizing NASA expertise, particularly that of White Sands Test Facility, or WSTF, and provide this training to NASA and Kennedy personnel.

Joe Hamilton, with Safety and Mission Assurance Support Services, obtained Ground Systems Development and Operations funding and authorization to develop this needed training course with the WSTF subject-matter experts, or SME, and the Kennedy pressure systems manager, or PSM.

These WSTF personnel presented the first version of this course at Kennedy in December 2014 to participants that included Kennedy's structural analysis group, Kennedy's PSM, Kennedy's International Space Station, or ISS, Safety, the NESC composite pressure vessel working group lead, and the co-lead of Kennedy's cryo tank mishap investigation.

The aftermath of a composite overwrapped pressure vessel that burst during testing at Kennedy Space Center's Cryogenics Laboratory On Dec. 23, 2008. Photo credit: NASA

Feedback from the course participants were used to update and improve the next course, which was presented in 2015 to Kennedy, Test and Operations Support Contract, and Boeing personnel.

Chris Keddy, the NASA pressure vessel blast fragmentation analyst SME taught this course along with training instructor Tommy Yoder to train engineers to evaluate the effects of pressure vessel rupture to ensure that employees and facilities are protected from overpressure and fragmentation in the event a pressure vessel failure should occur.

Composite overwrapped pressure vessel, or COPV, technology is used in virtually all current and planned launch vehicle systems and satellites because COPVs offer a high strength-to-weight ratio for the containment of high-pressure fluids. This type of analysis previously was performed by the WSTF SME to determine the effects of a COPV rupture on the ISS, while in orbit, and also for ISS and nitrogen oxygen recharge system, or NORS, COPV ground processing in Kennedy's Space Station Processing Facility to determine appropriate safety clears and access restrictions to ensure personnel safety while processing these COPVs.

Yoder said the vessels are roughly half as heavy and twice as strong as metal pressure vessels. "Lighter weight makes them extremely desirable for space applications," said Yoder, who is the COPV Special Projects manager with NASA at Johnson Space Center's WSTF in New Mexico. This is his ninth COPV-related training session at Kennedy since 2005, including teaching COPV damage control and inspection courses.

"The hands-on training is so important in order to meet NASA's requirements for safety and mission assurance," Yoder said. "It's important to detect COPV damage before they are used on aerospace missions." Yoder said damage could occur during manufacturing, delivery, integration or handling before and during a flight.

Yoder said every Kennedy worker who is involved in the ground processing of COPVs should handle them with care so they will not become damaged and to be aware of the detection methods used in order to extend the life of the tanks in space.

WSTF personnel have worked with many programs including NORS and JAXA to ensure damage control plans and training are adequate to ensure a high level of confidence is achieved when using this enabling technology.

For further information on this training, call Tommy Yoder at 575-524-5790 or Joe Hamilton at 321-861-1809.

MENTORING WITH A TWIST

Mentors shared their experiences with co-workers during the inaugural Mentoring with a Twist sponsored by the Disability Awareness and Action Working Group, or DAAWG, at the Operations Support Building II on Aug. 20. Photo credit: NASA/Kim Shiflett

Peers discuss disability, answer questions in 'speed dating' format

BY FRANK OCHOA-GONZALES

Kristin Cummings woke up on Dec. 19, 2012, with two sore ankles. The next day, she started experiencing a burning sensation in her lower back. After dinner that evening, Kristin began losing sensation in her legs. And within an hour, she lost the ability to stand. By the next day, she was paralyzed from the chest down. Kristin spent the next two months in the hospital and was eventually diagnosed with transverse myelitis, a rare neuro-immune disorder. Cummings along with 11 other mentors shared their experiences with co-workers during the first Mentoring with a Twist sponsored by the Disability Awareness and Action Working Group, or DAAWG, at the Operations Support Building II on Aug. 20.

Cummings, Kennedy Space Center's Pathway Intern of the Year, works at the weather office and says she received a lot of positive feedback during the event.

"It felt great to spread the world about my situation in such a safe environment," Cummings said. "It was nice to share my story with so many who wanted to know my story."

Ed Tugg, left, a Logistic Management specialist in the Launch Services Program, or LSP, shares his experiences during the inaugural Mentoring with a Twist sponsored by the Disability Awareness and Action Working Group, or DAAWG, at the Operations Support Building II on Aug. 20. Photo credit: NASA/Kim Shiflett

NASA employs more than 120 persons with self-identified disabilities at Kennedy, 20 of whom have targeted disabilities.

The 12 mentors, most of whom work at Kennedy, spent several minutes with a small group of Kennedy workers and the timer was ticking.

The mentors included:

Dr. Bryan Batien of the Orlando VA Medical Center, a clinical psychologist, shared his insight on post-traumatic stress disorder, or PTSD.

Andi Meyer, a Workforce Planning lead who discussed spinal cord injuries, said, "It could happen to you or someone you love; people need to learn about it."

Walt Hersing, an Employee Assistance Program, or EAP, counselor at Kennedy, explained all support services the EAP offers.

Parker Ward, a professional pilot for 18 years before a snowmobile accident in 2004 ended his career due to a spinal cord injury that left him paralyzed from the chest down, brought his dog Denver and talked about service dogs. Ward in not a Kennedy employee.

Ed Tugg, a Logistic Management specialist in the Launch Services Program, or LSP, spearheaded the campaign to get American Sign Language, or ASL, interpreters here at Kennedy. The American Disabilities Act of 1990 brought about several advances, including the ability of the deaf to use the telephone.

"When I first started here there were no interpreters provided. They would have to call a contractor and give them a week or two notice to have them come out to a meeting — so I missed a lot — until they hired interpreters," Tugg said.

Communication has gotten much better now that there are sign-language interpreters on staff and video phones where facial expressions can be seen.

Janet Steiner, of the Brevard Alzheimer's Association, addressed Alzheimer's and its effects on her family.

Michelle McCullough, who works in the Human Resources Workforce Planning Office, shared her experiences of her youngest child who has Williams Syndrome.

Pat Johnson, who has worked at Kennedy for the past 30 years, 27 of which have been in Human Resources, described her "hidden disability" called epilepsy.

Genny Ayala, a program analyst at Kennedy, is spreading awareness around the workforce about her hearing disability.

Annie Williams, an Environmental Protection specialist, shared her experiences with fibromyalgia.

Eddie Wroblinski, the disability program manager with Kennedy's Office of Diversity and Equal Opportunity, informed employees about reasonable accommodations for individuals with disabilities.

"Since I have been here, the center has been absolutely, 100 percent, responsive to employees who request accommodations," Wroblinski said.

DAAWG is an advisory group to the center director on matters relating to employees with disabilities, as well as a resource to the Office of Diversity and Equal Opportunity, Workforce and Diversity Management Office, and other directorates.

Kennedy has made many center improvements in order to provide a safer and more accessible work environment for its workers with physical disabilities.

October is National Disability Employment Awareness Month.

Disability Awareness and Action Working Group

DAAWG

Q&A

JESSICA CONNER

What is your job?

My job title is Equal Employment Opportunity Specialist. I have been working with the Office of Diversity and Equal Opportunity, or ODEO, for four years. I enjoy a variety of responsibilities in the ODEO including developing communication tools to raise awareness about the overall resources ODEO provides to the Center, delivering presentations to the managers and supervisors on the awareness about disabilities, working with the Employee Resource Groups on center, do reasonable accommodations for individuals with disabilities, and more.

What are some daily obstacles your must overcome to get your job done?

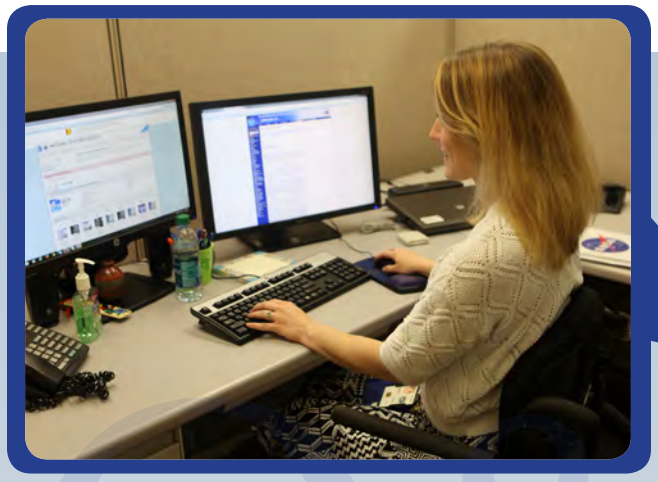
Communicating with co-workers and customers is one of my daily obstacles I must overcome to get my job done. Many people assume I can lip-read and speak for myself because of other Deaf employees they have met before me. Thankfully, Kennedy Space Center provides American Sign Language, or ASL, interpreters which I utilize every day. I also have a video phone in my office which I can use to make phone calls.

What motivates you to persevere?

My family motivates me to work hard so I can achieve my dreams, even if I have to overcome barriers being a Deaf person. Being a role model for Deaf children is another motivator for me. I want to show Deaf children that they can make their dreams happen if they do not let their barriers get in the way and ignore people who say that they cannot do it because of their deafness.

What is something everyone should know about you?

My younger brother and I are the only people in our family who are Deaf, but many of them learned ASL to communicate with us.



KRISTIN CUMMINGS

What is your job?

I am a Pathways Program intern working full-time in Kennedy Space Center Weather in the SI Directorate. My responsibilities include (1) working with the Lightning Advisory Panel (LAP) as they review and revise the Lightning Launch Commit Criteria (LLCC), (2) chairing the LLCC working group, which discusses any updates made by the LAP to the current set of LLCC and any issues the Launch Weather Officers experienced while applying the criteria in real-time during a launch, and (3) taking on some administrative tasks related to grants and budgets.

What are some daily obstacles your must overcome to get your job done?

The biggest one is asking co-workers for assistance, whether it is (1) traveling to and from work or between buildings for meetings, (2) needing help reaching an item that is too high or low, or (3) being unable to get into an office or conference room with a closed door that is not handicap accessible. I have always been a fairly independent person, so realizing that it's ok to ask for help has been a huge challenge.

What motivates you to persevere?

The thought that one day I'll walk again, whether it's by my body naturally healing or due to science. I'm continuously reminded by my family and friends that I can still do everything I did before, and more, and that I should never give up. My husband, though, is one of my biggest cheerleaders and everyday I push myself a little harder because I want nothing more than to walk down the aisle to him when we renew our vows or to hike Mt. Kilimanjaro together.

What is something everyone should know about you?

If you tell me that I can't accomplish something, I will do everything in my power to prove you wrong. So watch out world, you'll see me walk again!

PAUL MOGAN

What is your job?

I'm in the Systems Engineering and Integration Division of the Ground Systems Development Operations, or GSDO, Program. Our group sets technical policies for GSDO.

What are some daily obstacles your must overcome to get your job done?

My eyesight is severely limited, so getting back and forth to work without being able to drive; I use a lot of assistive technology devices to help me perform my daily job tasks.

What motivates you to persevere?

It's who I am. I want to contribute to NASA. I want to contribute to launching astronauts from American soil.

What is something everyone should know about you?

I'm just a regular person and I deal with challenges just like everyone else. Because I don't use a cane to get around, my disability is somewhat hidden.

KSC Scenes

Launch Pad 39A at Kennedy Space Center continues to take shape as SpaceX has completed the road from its processing hangar to the top of the launch stand.
A transporter-erector will move the Falcon 9 and Falcon Heavy rockets to position them above the flame trench for liftoff on flights carrying astronauts to the International Space Station and other launches. The rockets and Crew Dragon spacecraft will be processed in the hangar being built at the base of the pad. SpaceX also continues upgrading the launch structure and pad area to modernize the facilities that supported historic launches of the Apollo-Saturn V missions and space shuttles.

Photo credit: NASA

NASA spinoff

NASA spinoffs impact the way you play

BY FRANK OCHOA-GONZALES

Have you ever wondered how space exploration affects your daily life? NASA support through funding, research and technology sharing has enabled mountains of innovation in the private sector, benefitting the field of science, the global economy and the daily lives of humans all over the world. These spinoffs of technology are everywhere, including the world of sport. Here are some examples:

Shock Absorbing Athletic Shoes

A modified form of woven-fiber fabric used as cushioning in space boots now is used in an advanced athletic shoe to assist basketball players do their best to defy gravity. Not only does this fatigue-reducing shoe actually absorb energy, but it also redistributes that energy back into the athlete with every step, measurably increasing overall athletic efficiency.

Three of the National Basketball Association's biggest all-stars – LeBron James, Kobe Bryant and Kevin Durant – have worn Nike shoes designed after NASA spacesuits. The shoes featured a "mission patch" designed for each basketball player.

Therapeutic cooling, heating suits

Based on systems that maintain safe temperatures inside NASA space suits, a pioneering company developed lightweight, therapeutic cooling and heating suits to provide comfort and healing to people suffering from heat stress and other ailments. Another branch of these technologies includes deep-tissue warmth and stimulation treatments for muscular stress therapy.

Golf Equipment Materials

NASA-created metal alloys are stronger than titanium and as elastic as plastic; a one inch bar of the material is able to lift 300,000 pounds. Used in industry applications from armor-piercing ammunition to medical implants and sharper-than-steel scalpels, these amazing alloys often show up today in advanced sports equipment. Also, NASA funded research that resulted in a commercial product to treat balance disorders and is now used in facilities and golf academies to help players achieve an effective, balanced swing.

Tennis Rackets

Vibration control improves the performance of skis, snowboards, baseball bats, hockey sticks and tennis rackets. Their improved technology began with the NASA-supported development of a thin electrode-filled self-powering patch, slightly bigger than a baseball card, designed to control noise and vibration and detect structural defects in the blades and wings of helicopters and airplanes.

Plasma Display

A manufacturer having trouble creating a new type of flexible plasma display called on NASA scientists for their expertise in metals, glass and ceramics. By developing the right combination of phosphate and glass, the scientists quickly provided a solution for adequate transparency in the small, gas-filled glass spheres needed to build the new large and curved-format displays.

Protective Padding

Football padding, baseball chest protectors, soccer shin guards and helmets use an innovative foam material originally created for aircraft seats. A company working with NASA found a way to increase passenger comfort and accident protection; the end result was a seat that evenly distributed a person's body weight across a seat's entire contact area.

Heart Rate Monitor

New heart-monitoring technology created to track the health of astronauts on deep-space missions was modified by a company for use in physical fitness equipment. An infrared heartbeat transmitter worn under clothing uses the heart rate to act as an exercise intensity control. Those who benefit from the ability to accurately read their heart rate and work-intensity levels include cardiac rehabilitation patients, orthopedically impaired patients, and elite athletes training to reach the ultimate physical condition.

For more information on NASA's spinoffs, visit: spinoff.nasa.gov

In The KNOW

Stott encourages women to take advantage of opportunities

BY BOB GRANATH

Retired NASA astronaut Nicole Stott recently spoke to employees at Kennedy Space Center during a celebration of Women's Equality Day on Aug. 26. The day marked the 95th anniversary of ratification of the 19th amendment to the U.S. Constitution granting American women the right to vote. Stott used the occasion to inspire women working in the space program to take full advantage of opportunities offered as NASA reaches for deep-space destinations such as Mars.

The event was sponsored by KNOW — Kennedy Networking Opportunities for Women. The newly chartered organization provides focus on issues that affect female employees, such as employment, retention, promotion, training, career/personal development and education. It also seeks to eliminate barriers that hinder the advancement of women in the workforce.

Stott credits her mentors and fellow employees at Kennedy for assisting with her career development in America's space program.

"I feel like this is the place that provided me with the opportunity to be here today," said Stott, who was born in Albany, New York, but grew up in Clearwater, Florida. Working at Kennedy provided "really wonderful opportunities opened up by being a part of something, by being excited by it and wanting to pursue it."

More than a century ago, many American women wanted to pursue the right to vote. Aug. 26, 1920 was the date the constitutional amendment officially went into law granting national women's suffrage. The bill to include women in the voting process first was introduced in Congress during

"Tell young people to pay attention to what inspires them. I am very thankful that I had parents who never used the word impossible."

– Nicole Stott
Retired NASA Astronaut

Top left, the Kennedy Networking Opportunities for Women logo was designed by Debra King, a Logistics specialist with Wichita Tribal Enterprises. Her entry was selected as the winner in August. The emblem presents a concept figure open to new ideas with outstretched hands. The six stars stands for the focus or mission of KNOW: employment, retention, promotion, training, career/personal development and Education. Image credit: KNOW/Debra King

Chrysler Aerospace artist Cecelia Bibby paints Friendship 7 on NASA astronaut John Glenn's Mercury spacecraft in early 1962. (She is wearing coveralls for McDonnell Aircraft, the Mercury spacecraft's prime contractor.) After selecting the name, Glenn insisted the individual who developed the artwork personally apply the paint. This was in spite of objections to the fact that women rarely, if ever, were allowed up the Launch Pad 14 gantry at Cape Canaveral Air Force Station. Photo credit: NASA

1878. The House and the Senate finally passed legislation proposing the amendment on June 4, 1919.
It was ratified by the required number of states just over a year later.

Like women participating in the political process, their role in America's efforts to explore space was a difficult road.

In early 1962, preparations were under way for John Glenn's flight as the first American to orbit the Earth. He decided to name his Mercury spacecraft "Friendship 7."

The script art for the name to be painted on Glenn's Mercury capsule was developed by Cecelia Bibby, an artist employed by NASA contractor Chrysler Aerospace. Glenn wanted her to hand paint the name on the spacecraft as it stood atop an Atlas rocket enclosed in the gantry at Cape Canaveral's Launch Pad 14.

Bibby's supervisor initially objected to her painting the name since women rarely, if ever, went up the launch pad towers. Glenn insisted and Bibby was allowed to apply the historic name to the Mercury 6 spacecraft. She later painted the names on Scott Carpenter's Aurora 7 and Wally Schirra's Sigma 7.

When Apollo 11 lifted off on the first moon landing mission on July 16, 1969, there were few women in the Launch Control Center and all except one were secretaries. JoAnn Morgan was the only woman engineer in the Firing Room. She played key roles as a member of the NASA launch team for information systems, communications and instrumentation services during many of the agency's early human spaceflight programs.

Later, Morgan became the first woman senior executive at Kennedy, retiring in 2003 as director of External Relations and Business Development.

In the late 1970s, as NASA began preparing for the Space Shuttle Program, a new breed of astronaut, called "mission specialists," was being recruited. They did not have to learn to be jet pilots, as the focus on shuttle missions would be on the payloads. Not only were pilots being hired, but also scientists, engineers and physicians. The diversity also included the first women and ethnic minorities.

Six women were selected in the 1978

In the Firing Room at the Kennedy Space Center on July 16, 1969, members of the launch team listen to congratulatory remarks by Vice President Spiro Agnew following the successful liftoff of Apollo 11. In the center of the photograph (see orange arrow) is JoAnn Morgan, the only woman engineer among scores of male counterparts. Photo credit: NASA

Judy Sullivan – "That Guy"

During a training exercise for the first lunar landing mission, NASA biomedical engineer Judy Sullivan monitors a console in the Kennedy Space Center's Manned Spacecraft Operations Building (now the Neil Armstrong Operations and Checkout Building). When astronauts were training for Apollo missions, they were fitted with small sensors that would provide crucial data about respiration, body temperature and heartbeats. As was the case in Projects Mercury and Gemini, the sensors kept flight surgeons informed on the health of the astronauts during the trips to the moon. Sullivan would monitor the equipment and ensure the information was provided to the proper sources. She was the first woman engineer hired by NASA to support spacecraft testing. As preparations were underway for Apollo 11 in mid-1969, the 26-year-old Sullivan was one of only 100 women, including 16 engineers, serving in top positions at the Florida spaceport. While well accepted by her male counterparts, she was often referenced as "That Guy" as a parody to the popular television show of the time, *That Girl*. Photo credit: NASA

group with Sally Ride becoming the first American woman in space in June 1983. Now, a new group of astronauts is selected every two to five years, each of which includes women.

Women now have served on space shuttle and International Space Station, or ISS, crews and performed spacewalks. Eileen Collins became the first woman to command a shuttle mission, STS-93 in July 1999. When Peggy Whitson served a six-month tour of duty aboard the space station, she was commander for Expedition 16 from October 2007 to April 2008.

A growing number of women in various disciplines successfully are performing in roles previously considered the sole domain of men. Capt. Kristen Griest and 1st Lt. Shaye Haver recently became the first women to graduate from the U.S. Army's grueling, 62-day Ranger School at Fort Benning, Georgia. The elite regiment often is referred to as the Army's premier direct-action raid force.

Stott was a member of the group of NASA astronauts chosen in 2000. Among three women selected for spaceflight that year, she joined a once exclusive fraternity that had belonged solely to men. She noted that her astronaut class was, indeed, diverse.

"We had an oceanographer, a geophysicist, a test pilot, an aeronautical engineer, we had a submariner," said Stott who earned a bachelor's degree in aeronautical engineering from Embry-Riddle Aeronautical University in 1987 and a master's in engineering management from the University of Central Florida in 1992. "To me, that's what you want on a flight crew. You want people who have different experiences, who have differed strengths and who can work together to make the mission a success."

In 1988, prior to becoming an astronaut, Stott was one of the ever-growing number of women engineers working for NASA and its contractors at Kennedy. As an operations engineer in the Orbiter Processing Facility, she held a variety of positions including shuttle flow director for the shuttle Endeavour, orbiter project engineer for Columbia and NASA convoy commander for shuttle landings.

Six women were among 35 NASA astronauts selected for the Space shuttle Program in 1978. Posing with an Apollo era moonwalking suit, from left, are Shannon Lucid, Rhea Seddon, Kathy Sullivan, Judy Resnik, Anna Fisher and Sally Ride. Photo credit: NASA

During her last two years at Kennedy, Stott was a member of the Space Station Hardware Integration Office and relocated to Huntington Beach, California. There she served as the NASA project lead for the ISS truss elements under construction at the Boeing space station facility.

"Having worked here, I had a huge advantage having had my hands on the actual hardware that was going to fly in space," Stott said about the start of her astronaut candidate training.

Once she had a chance to fly a

Left to right: Clara Wright, materials engineer in the Kennedy Space Center failure analysis laboratory. Photo credit: NASA/Dimitri Gerondidakis
Hibah Rahmani, avionics and flight controls engineer in NASA's Engineering and Technology Directorate. Photo credit: NASA/ Dan Casper
Annie Caraccio, chemical engineer in the Analytical Laboratories Branch of the Engineering and Technology Directorate. Photo credit: NASA/Dan Casper

space shuttle mission to the ISS, Stott described the station as a magnificent facility.

"I still get goose bumps thinking about the research and science aspects of what's going on there," she said. "We worked together with international crews to make it happen. It's a beautiful example of how we should cooperate on other things here on Earth."

Stott was launched to the space station with the crew of STS-128 in August 2009, participating in the first spacewalk of that mission. She spent 90 days working aboard the ISS as a member of the Expedition 20 and 21 crews. Stott returned aboard STS-129 in November, becoming the last station crew member to return to Earth aboard the shuttle Atlantis.

Stott completed her second spaceflight in 2011 on STS-133. The crew transported several items to the space station, including the Permanent Multipurpose Module Leonardo, which was left docked to one of the space station's ports.

Now retired from NASA, Stott explained that she is pursuing a career as a full-time artist. Stott also wants to inspire young women and men to consider careers in STEM — science, technology, engineering and math.

"Tell young people to pay attention to what inspires them," she said. "I am very thankful that I had parents who never used the word impossible. They never discouraged me. Encouragement is what makes powerful things happen."

Similar efforts of encouragement now are showing results at NASA. To date, 59 women have flown in space, 45 of whom, including Stott, are citizens of the United States.

Women now make up 33 percent of the Kennedy workforce. In fact, during fiscal year 2015, 48 percent of civil service new hires at the center were women. That is comparable to similar numbers being recorded in the nation's civilian labor force.

Women serve in many key roles at Kennedy, including Deputy Director Janet Petro. She began her professional career as an officer in the United States Army after graduating in 1981 from the U.S. Military Academy at West Point, New York. Hers was only the second class to include women.

Clara Wright is a materials engineer in the failure analysis laboratory at NASA's Kennedy Space Center. Wright is an expert in materials engineering, metallurgy, microscopy and failure analysis. She has supported several research investigations at Kennedy, including testing and microscopy of advanced composites systems and support to other center research projects.

One of those new areas of study is called "SMASH," for Shape Memory Alloy Self-Healing. It is a technology that creates metals that, when damaged, can repair themselves.

Hibah Rahmani is an avionics and flight controls engineer in NASA's Engineering and Technology Directorate. She supports Kennedy's Launch Services Program, assisting with the liftoff of rockets from Kennedy and Cape Canaveral.

Rahmani likes to encourage young people, especially girls, to "stay focused and dream big."

Annie Caraccio is a chemical engineer in the Analytical Laboratories Branch of the Engineering and Technology Directorate. Caraccio served on a team studying a technology that could turn ordinary debris and other garbage accumulated by a crew of astronauts into valuable resources such as methane gas, oxygen and even water, using processes that currently are used on Earth.

KNOW unofficially was formed in March 2014, as the Federal Women's Program and is currently chaired by Joette Feeney, Kennedy's Federal Women's Program manager, with Brandi Higgins of Kennedy Human Resources serving as co-chair.

"We started with about a dozen employees getting together to talk about forming a group," Feeney said. "This year the organization decided to become an Employee Resource Group, working on a charter and rebranding ourselves with the different name."

In Memoriam

Walter Kapryan
1931-2015

NASA remembers Apollo Launch Operations manager

BY BOB GRANATH

Walter (Kappy) Kapryan, whose career with NASA and America's space program spanned more than three decades, died Aug. 14, 2015. He was 95.

A resident to Indialantic, Florida, Kapryan served as Launch Operations director during the Apollo and Skylab Programs. He also supported the early years of the Space Shuttle Program with Lockheed Space Operations Co.

When he retired from NASA in 1979, he was praised by, then, Kennedy Space Center Director Lee Scherer.

"Kappy has devoted a major portion of his life to the space program and has made many major contributions to its success," he said.

Born in Flint, Michigan, in 1920, Kapryan attended Wayne State University in Detroit. In 1943 he left school and entered the U.S. Army Air Force as a first lieutenant, serving as a B-29 flight engineer during World War II. Following the war, he returned to Wayne State, graduating in 1947 with a degree in aeronautical engineering. Later that year, Kapryan joined the National Advisory Committee for Aeronautics (NACA) at the Langley Research Center in Virginia, working in the field of hydrodynamic research.

After the NACA became NASA in 1958, the fledgling space agency's Space Task Group was formed at Langley. Their primary mission was to develop a program to put an American in space.

Kapryan joined the Space Task Group in March 1959 and was appointed project engineer for the Mercury Redstone 1 (MR 1) spacecraft and moved to Cape Canaveral Air Force Station in I960.

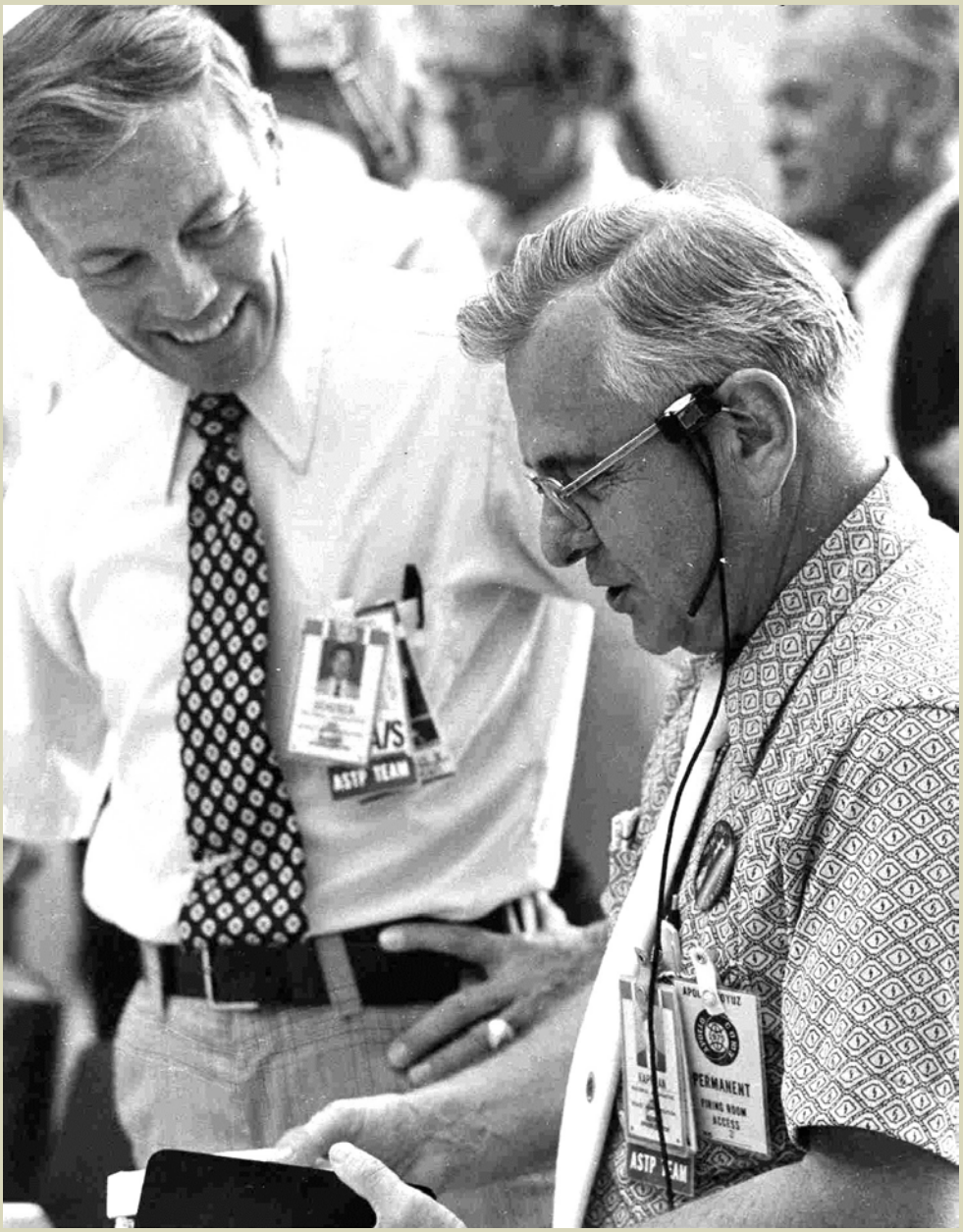
MR 1 was to be the first unpiloted, sub-orbital test flight of the spacecraft that would put the first American in space. Kapryan also was in the Cape's Launch Pad 5 blockhouse as a project engineer when Alan Shepard was launched atop a Mercury Redstone on May 5, 1961.

Kapryan continued supporting Project Mercury until 1963. That year, he established and led the Manned Spacecraft Center's Gemini Program Office at Kennedy. During the early phases of the Gemini Program, Kapryan was responsible for planning of spacecraft testing. He also helped determine requirements for Gemini capsule checkout equipment to be located at Kennedy. He went on to participate in the preparation and countdown of all 10 piloted Gemini flights.

Kapryan then served as assistant Apollo Spacecraft Program manager at Kennedy representing the Manned Spacecraft Center, assuring coordination between the two centers for spacecraft operations. He later was appointed deputy to Rocco Petrone, who was director of Launch Operations.

At Kennedy, the Apollo Program not only involved test flights of the spacecraft, as well as the Saturn 1B and Saturn V boosters, but development and construction of the massive infrastructure including the Vehicle Assembly Bulling, Launch Control Center and Launch Pads 39A and B.

After supporting Petrone with the early Apollo launches, Kapryan assumed the position of director of Launch Operations with Apollo 12 in November 1969. He served in that role through Skylab and the 1975 lift off of the Apollo-Soyuz Test Project (ASTP) mission.



Kennedy Space Center Director Lee Scherer, left, congratulates Director of Launch Operations Walter Kapryan following the successful liftoff of the Apollo Soyuz Test Project in July 1975. Photo credit: NASA

Following Apollo, Kapryan was Kennedy's first director of Space Shuttle Operations.

At the time of Kapryan's retirement on June 1, 1979, many who worked closely with

In the blockhouse of Launch Pad 34 at Cape Canaveral Air Force Station, Deputy Director of Launch Operations Walter Kapryan, left, confers with Director of Launch Operations Rocco Petrone during the Flight Readiness Test for the countdown of Apollo 7 in October 1968. Photo credit: NASA

him recalled his extraordinary coolness and judgment made the difference between success and failure.

"During the terminal countdown for the ASTP mission, a crucial "Go-No Go" decision had to be made in real time on a hydraulic oil leak problem in a critical swing arm system," said Ike Rigell, acting director of Shuttle Cargo Operations. "Kappy very quickly analyzed our work-around capabilities and made the right decision to continue the count and launch on time,"

In the early 1980s, Kapryan moved to industry, serving as chief technical advisor for NASA's Shuttle Processing Contractor, Lockheed Space Operations Co.

In September 1992, the National Space Club's Florida committee awarded the group's first Lifetime Achievement Awards to Kapryan and Robert Gray, the first director of Kennedy's Space Shuttle Projects Office.

"I can't think of two more deserving individuals for these initial Lifetime Achievement Awards," said George English, the space club's Florida chairman. "Both Bob and Kap are widely recognized as true pioneers of the space business now routinely conducted on Cape Canaveral Air Force Station and at the Kennedy Space Center."

Toward the end of his career, Kapryan expressed his view that the most important achievement in spaceflight was the people who made it happen.

"To me the outstanding thing has been the development of a truly skilled and dedicated team," he said. "They have been the driving force behind America's space program."

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>
> **– Walter (Kappy) Kapryan**

Mars enthusiasts around the world can participate in NASA's journey to Mars by adding their names to a silicon microchip headed to the Red Planet aboard NASA's InSight Mars lander, scheduled to launch next year.

Submissions will be accepted until Sept. 8.

To send your name to Mars aboard InSight, go to:

http://go.usa.gov/3Aj3G

For additional information about the InSight mission, visit:
http://www.nasa.gov/mission_pages/insight/main/index.html

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