National Aeronautics and Space Administration

AEROSPACE Frontiers

VOLUME 16 ISSUE 8 AUGUST 2014

Glenn-Industry Partner in "Green" Propellant Research

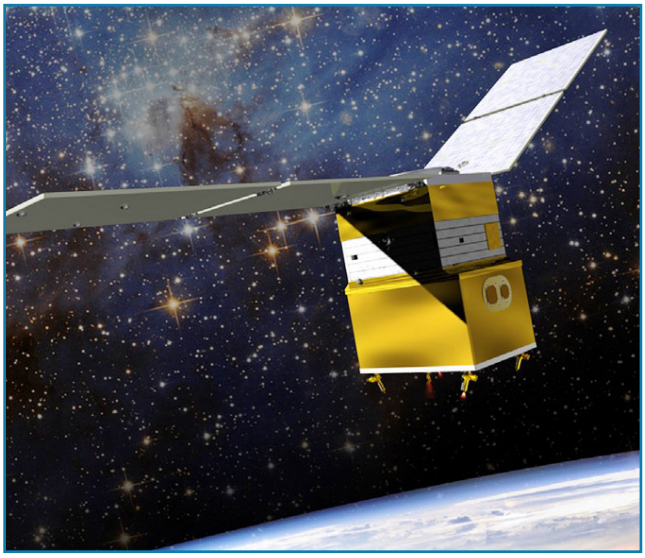
Project May Revolutionize Spacecraft Propulsion

NASA Glenn researchers have completed a series of tests in Glenn's Rocket Combustion Laboratory to help develop a "green," nontoxic propellant for space applications. The project may revolutionize how we safely and efficiently propel new generations of exploration and science missions through space.

Glenn is part of the Green Propellant Infusion Mission (GPIM) team that is developing a flight demonstrator to demonstrate the performance of the nontoxic, hydroxylammonium nitrate (HAN)-based monopropellant in space for the first time and compare it to conventional monopropellants. Developed by the Air Force Research Laboratory, this propellant (aka AF-M315E) offers nearly 50 percent higher performance and efficiency compared to the traditional monopropellant hydrazine system.

Glenn is a co-investigator with Ball Aerospace & Technologies Corp., Boulder, Colo., on the GPIM team. Aerojet Rocketdyne, Redmond, Wash.; the U.S. Air Force Research Laboratory at Edwards AFB,

Continued on page 2



Artist rendering of GPIM on Earth orbit. Credit: NASA

Exploring the Titan Seas in a Submarine—Imagine That!

Building a submarine to explore oceans on another planet might seem like a pipe dream to some, but at NASA turning dreams into reality is what it does best.

Each year, the NASA Innovative Advanced Concepts (NIAC) program encourages researchers to dream big and submit ideas for space technology that might benefit a NASA mission in a few decades. This year, NIAC chose the proposal for "Titan Submarine" submitted by Steve Oleson and his colleagues on the COMPASS (Collaborative Modeling for Parametric Assessment of Space Systems) team at NASA Glenn. The proposal is among a dozen that received $100,000 each for a 9-month study, with the possibility of another $500,000 for further research.

"We proposed a basic design of a submersible autonomous vehicle to probe the depths of Kraken Mare, the largest northern sea on Titan—Saturn's largest moon," Oleson explained. "It's

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New Operating Structure Now Under Way

NASA Glenn began operating under its new organizational structure on June 29. The new structure strengthens the center's competencies and capabilities, stimulates innovation and enhances integration within its technical areas.

"By aligning the center's goals and core competencies, the new organizational structure creates efficiencies and interdependencies, while positioning the center for new opportunities in research and development," said Glenn Center Director

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In This Issue

Titan Seas Submarine

Continued from page 1

a far-out idea, but it's something I think we can definitely do engineering-wise."

Kraken Mare is comparable in size to the Great Lakes. What lies beneath the surface of the seas, however, makes Titan one of NASA's most interesting targets for exploration after Mars. Unlike hydrogen oxide (water) that flows through Earth's lakes, oceans and rivers, Titan seas hold liquid methane and ethane—hydrocarbons that keep the surface at a supercool 290 degrees below zero Fahrenheit (–179 degrees Celsius).

Artist illustration for the proposal Titan Submarine exploring the depths of Kraken Mare.

So what will the submarine look like and how will this out-of-this-world mission advance NASA planetary exploration? Oleson says the COMPASS team does not offer an optimum design; rather, it delivers realistic parameters with a master list for hardware, a power system and controls. However, one of several mission takeaways is the potential to advance space communication and navigation. Submarines on Earth frequently surface to communicate because radio waves do not penetrate very far through water. That may not be an issue on Titan.

"Hydrocarbons should be transparent to radio waves, so the sub could beam data up to an orbiting relay satellite without a break in exploration," Oleson said. "The NIAC grant offers the team the opportunity to explore this and other ideas, such as liquid hydrocarbons as fuel for a future mission."

For a complete description of the proposal, visit http://www.nasa.gov/content/titan-submarine-exploring-the-depths-of-kraken/. To learn more about COMPASS, visit http://engineering.grc.nasa.gov/labs.htm#COMPASS.

—By S. Jenise Veris

Green Propellant Research

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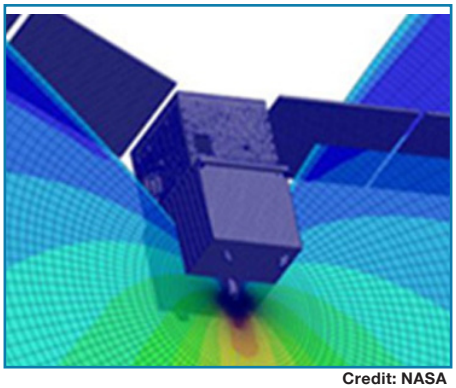
Calif.; the Air Force Space and Missile Systems Center at Kirtland AFB, N.M.; and NASA's Kennedy and Goddard Space Flight field centers round out the team.

Over the past year, Glenn GPIM members have analyzed plume impingement on the GPIM spacecraft using a combination of computer simulations and laser imaging from hot-fire testing on laboratory model thrusters.



The plume model developed from the computer simulations.

The team took particular interest in the impacts of plume impingement on the spacecraft's solar arrays.

"Plume impingement can cause both chemical contamination and erosion of the spacecraft's solar cells and induce damaging thermal and force loads on the solar array wings, which could result in a partial or total loss in solar array power," said Glenn Team Lead Matt Deans, Ascent and Thermal Propulsion Branch. "Our diagnostic technology has enabled the gathering of a wide range of data to characterize the thruster plume and its potential impact."

The Glenn team includes Matt Deans, Brian Reed, John Yim, Kristen Bury, George Williams (OAI), Lynn Arrington, Dave Frate and Tim Smith. To date, their testing and analysis has made significant progress in characterizing the plumes of this new propellant to determine best design practices and capturing what, if any, impact may occur. Advanced testing on the engineering (flight-ready) thrusters is scheduled to begin this month.

The GPIM team will fly the propellant demonstrator as a subsystem on a Ball BCP–100 spacecraft bus with an Aerojet modular propulsion system. It is the first time the nation will fly a spacecraft to test green propellant technology. It is scheduled to launch on the Air Force's STP–2 mission aboard a Space-X Falcon Heavy in late 2015.

—By S. Jenise Veris

Glenn Early Career Employees Network With Others

Early career employees from the two premier aerospace institutions in Ohio—NASA Glenn Research Center and Wright Patterson Air Force Base (WPAFB)—recently came together to renew acquaintances and cultivate partnerships.

On June 25, Glenn's Developing Professionals Club (DPC) members showcased Glenn technology to visiting members of WPAFB Junior Force Council (JFC). Similar to Glenn's DPC, the JFC is an early career group that focuses on developing employees into strong, competent and motivated leaders.

While at Glenn, JFC members toured nine Lewis Field facilities, including the experimental hangar, the 10- by 10-Foot Supersonic Wind Tunnel and the Ballistics Impact Lab, to learn more about the center. The group also had an opportunity to visit Plum Brook Station. The event included gatherings at a local restaurant and onsite picnic to stimulate social networking.

"Last fall, the DPC received the red carpet treatment from the JFC and toured many of their facilities in Dayton," said DPC member Bill Fabanich, Thermal Systems Branch. "We enjoyed the event so much that DPC members wanted to reciprocate the hospitality by hosting a site visit to Glenn."

Fabanich said Plum Brook Station Director Dave Stringer was instrumental in facilitating the exchanges. Debbie Goodenow, DPC co-chair, and Andrea Helbach, JFC, coordinated the tours. Additionally, several senior career level employees enthusiastically provided support for the recent event.

Photo by Jason Wolf

Photo by Doreen Zudell

Top: Julie Kleinhenz, right, shares research highlights with the group during a tour of the Simulated Lunar Operations Laboratory. Above: DPC and JFC members enjoy lunch and a presentation by Matt Moran, Venture and Partnerships Office.

"Experiences such as these offer early career employees opportunities to see the world beyond their own perspective," Stringer explained. "They also enable a robust professional network and stimulate collaboration."

—By Doreen B. Zudell

New Operating Structure

Continued from page 1

Jim Free. "Aligning like functions should also stimulate new thinking and intercenter cooperation, while providing flexibility to cross-train personnel."

The key element of the reorganization is a new operating structure that realigns two former directorates into one. A newly established Research and Engineering Directorate is made up of five divisions—power, propulsion, materials and structures, communications and intelligent systems, and systems engineering and architecture—that focus on Glenn's competency based functions. The new organization will be able to quickly adapt to changes in priorities and reduce duplicative investments in different organizations.

Other highlights under the new structure include: the Aeronautics Research Office was renamed to the Aeronautics Directorate; the Office of Technology Partnerships and Planning was changed to the Office of Technology Incubation and Innovation; and the Facilities and Test Directorate added to its portfolio manufacturing functions previously performed in another organization and renamed the Facilities, Test and Manufacturing Directorate.

For more information, visit https://www.grc.nasa.gov/reorganize/ (internal only).

Glenn Cafe Revs Up Lunch

C-2014-3313

C-2014-3346 Photos by Michelle Murphy

Classic and sporty cars and motorcycles lined Taylor Road during the Glenn Cafe Wheels and Meals Cruise-In on July 9. Employees enjoyed lunch from food vendors while listening to music by the NASA Jam Band. A Best Tropical Shirt contest drew several festive contenders. Pictured, right: Employees check out the features of vehicles on display. Pictured, far right: Paul Starner (in hat), Systems Management Branch, takes first place in the shirt contest. The Glenn Café Food Services Pilot Program team sponsored the event. To stay up to date with Glenn Café vendors and events, subscribe to the Café mailing list at https://lists.nasa.gov/mailman/listinfo/glenn-cafe.

C-2014-3365 Photo by Michelle Murphy

Glenn, JPL Review Mutual Interests

Director of the Jet Propulsion Laboratory (JPL) Dr. Charles Elachi visited Lewis Field, July 16. Elachi toured several facilities and discussed three major areas of mutual interest with Glenn—the Space Communications and Navigation Program, Asteroid Redirect Robotic Mission and Solar Electric Propulsion Project. Five members of JPL's executive council, Dr. Jakob van Zyl, Leslie Livesay, Brian Muirhead, Dr. Firouz Naderi and Keyur Patel, accompanied Elachi. Pictured: Dr. Phillip Abel, left, Mechanisms and Tribology Branch, briefs Elachi, next to Director Jim Free, and guests on Simulated Lunar Operations Laboratory research.

Middle School Students Prepare for Robotics Challenge

C-2014-2922 Photo by Michelle Murphy

More than 50 students from four central Ohio summer programs participated in a field day at NASA Glenn, June 16. The visit was part of the 5-week curriculum to gain insight into the programming required for this year's Zero Robotics Middle School Summer Program game challenge. The program introduces students to computer programming, robotics and space engineering, and provides hands-on experience programming SPHERES (Synchronized Position Hold, Engage, Reorient, Experimental Satellites). Pictured: Jomill Wiley, Office of Education, guides students working to develop their game strategy. The Zero Robotics program is developed by the Massachusetts Institute of Technology with the support of NASA, the Defense Advanced Research Projects Agency (DARPA) and the Center for the Advancement of Science in Space (CASIS).

Professional Organizations Recognize Glenn Newsletter, Social Media

Glenn's *AeroSpace Frontiers* newsletter staff, Kelly DiFrancesco, Doreen Zudell and S. Jenise Veris (SGT), earned an Award of Excellence in the "Internal Newsletter" category from the National Association of Government Communicators (NAGC). The editors received the award during the NAGC 2014 Blue Pencil & Gold Screen Award Ceremony, June 12, in Washington, DC. The national award recognizes superior communications efforts of government agencies and the people who create the products.

Also in June, Glenn's Social Media Team, Kathy Zona, Nancy Kilkenny (SGT) and Kelly Heidman (WYLE), received an APEX Award of Excellence in the category of Special Purpose Social Media for a Reddit "Ask Me Anything" chat. Reddit is a social media forum where the public joins in question-and-answer sessions on any number of topics. The team coordinated the event with Reddit and NASA's Social Media Headquarters group and recruited four ion propulsion engineers who took 2 hours of questions from "redditors" around the world.

Summer Internships Open Doors to STEM Careers

Theoretical learning is the foundation to any field of study, but there comes a time to put down the books, roll up the sleeves and dig into the discipline.

This summer, a combination of 186 high school, undergraduate and graduate students are doing just that. They are participating in a number of NASA internship programs designed to expand the student's understanding of technical, professional administrative fields and career choices. By working at Glenn facilities—under the guidance of scientists, engineers, technicians and business professionals—students are engaging in authentic NASA-related, mission-based research and development and potential career-related activities.

"NASA internships provide hands-on research and professional business experiences that broaden the students' interests in the aerospace industry," said Vanessa Webbs, Office of Education. "A successful internship is one of the most important factors in a students' ability to obtain a job after graduation. Internships challenge students to compete in the global arena."

Students are not the only ones benefitting from these summer internships, however. In many cases, their efforts are helping to further NASA's research and meet its mission goals.

Students seeking to participate in NASA internships should apply at the OSSI website at http://intern.nasa.gov.

—By Doreen B. Zudell

High School, Undergraduate, Graduate Student Spotlight

Biltz

Melissa Biltz, senior, Laurel High School, Shaker Heights, Ohio

Glenn High School Internship Project (GHIP)

Mentor: **Dr. Fred Dynys**, Materials Chemistry and Physics Branch

This is Biltz's first summer at Glenn. She is undertaking a variety of tasks—from reviewing and summarizing technical papers to analyzing ceramic materials—related to thermal electric batteries for space applications. Her efforts could lead to identifying new materials for batteries to power future satellites.

"This internship is an amazing opportunity for me because it's directly applicable to my technical interests," Biltz said. "I'm learning while at the same time getting paid for doing what I love."

Culver

Michael Culver, junior, Oakland University, Rochester, Michigan Mathematics and Physics Major

LERCIP Space Communications and Navigation Summer Internship (SCaN) Project

Mentor: **Joseph Warner**, Architectures, Networks and Systems Integration Branch

This is Culver's second summer internship at Glenn. This year he is developing software tools related to communication subsystems design and analysis in spacecraft, and a model for the plasma plume profile of an ion thruster. Ultimately, his contributions could save significant time in the design of future missions.

"Being at Glenn is an incredibly fulfilling experience," Culver said. "I've gained a great deal of technical skills working alongside the world-class subject-matter experts and experienced a depth and breadth of Glenn's work that has been truly remarkable."

Rodier

Bradley Rodier, graduate student, Case Western Reserve University, Cleveland, Ohio, Chemistry Major Jenkins Graduate Fellowship Program

Mentor: **Dr. Michael Meador**, Materials and Structures Division

Rodier's research involves experimenting to improve the quality of polymers commonly used by NASA. This summer he is using functionalized graphene to see if the platelets can be worked into the polymer matrix. The characteristics he is hoping to improve are strength, durability and conductivity.

"Being at NASA allows me access to state-of-the-art tools and people of a high technical caliber that I would not normally have at the graduate level," Rodier said. "This experience is a dream come true for me as I'd love to work at a national government laboratory such as NASA."

Emmy-Award-Winning Production Features Glenn

A NASA video program about how new methods of power and propulsion are being developed and featuring employees and facilities at Glenn has earned a regional Emmy Award.

The video, "Power and Propulsion," won in the category of Informational/Instructional—Program/Special. NASA X, a television program and vodcast that highlights new and emerging technologies at NASA, operates out of NASA Langley. One segment about solar electric propulsion took viewers on a tour of Plum Brook Station's Space Power Facility, explained how fuel cells work and described the intricacies of one type of solar electric propulsion, the Hall thruster.

To view the award-winning NASA X "Power and Propulsion" program, visit http://www.youtube.com/watch?v=0iYXnjqylbM.

Awards, Honors & Promotions

The American Institute of Aeronautics and Astronautics (AIAA) acknowledged the technical achievements in aerospace science of two Glenn retirees during the 2014 AIAA Aviation Forum in June. **Edward Rice**, retired aerospace engineer, received the AIAA 2014 Aeroacoustics Award for his seminal contributions to the theories of aircraft engine duct noise radiation and grazing flow liner optimization. **Jeffrey Haas**, retired chief of the Testing Division, received the AIAA 2014 Ground Testing Award for exceptional management of Glenn's test facility assets. He was also recognized for significant contributions to advance aerodynamic propulsion ground testing and for leadership and service to AIAA.

Rice

Haas

Arnett

The team of NASA Glenn, City of Cleveland, Cuyahoga County and MAGNET has earned a 2014 Team NEO Economic Development Plus Award for "Regionalism & Cross-Border Collaboration." NASA was recognized for providing technical support to 8 small Northeast Ohio companies that were facing technical or manufacturing challenges. The Team NEO Economic Development Plus Awards recognize economic development efforts throughout the 18-county region of Northeast Ohio that have helped to retain companies, create jobs and bring foreign investment to the region.

Lori Arnett has been selected facility manager for the Research Combustion Laboratory, the Small Multi-Purpose Research Facility, and the Fuel Cell and Materials Facility in the Facility Management and Planning Office. She had been lead test engineer in the Cryogenic Propellant Storage and Transfer Program.

Welcome to the NASA Family

Glenn welcomed the following new employees and the Pathway and Veteran interns who reported for duty/orientation in June. Heather Blum, Safety, Health & Environmental Division; Joshua Dumont, Integration Office; Daniel Goddard, Office of the Director; Rosana Maringolo-Baldraco, Intelligent Control and Autonomy Branch; Bridget Popovic, Engineering Management Branch; Sydney Schnulo, Propulsion Systems Analysis Branch; Luke Sorrelle, Space Power & Propulsion, Communication and Instrumentation Branch; and Alison Sufka, Accounting and Reports Branch.

Editor's note: Organization affiliations listed may include those assigned prior to the Glenn reorganization.

Sufka and Schnulo

Dumont

Left to right: Blum, Popovic and Maringolo-Baldraco

Sorrelle and Goddard

In Appreciation

At a time when life is so very sad and difficult with the sudden loss of my son, it is so refreshing to feel the kindness and generosity people have given me from both Plum Brook Station and Lewis Field. I am truly blessed to work with such wonderful, caring people!

—Dawn Schneider

NASA AGENCY HONOR and CENTER AWARDS

Friday, Sept. 12
10:00 a.m.
MIC Auditorium
Building 162

Retirement

Ronald Alexander, Office of the Director, retired May 31, 2014, with 33 years of NASA service.

Alexander

More Than a Memory


Fenner


Lalli


Reyes

Everett C. Armentrout, 87, a 1989 retiree with 26 years of service, died Nov. 1, 2013. He was a U.S. Army Veteran of World War II who began his NASA career in 1963. Armentrout received numerous awards for the design and development of instrumentation, notably for jet engines and the operation and control of the Atlas-Centaur (AC-68). The rocket launched the Navy's FLTSATCOM-8 (Fleet Satellite Communications System) satellite. He authored several NASA Tech Briefs in the area of pressure transducers.

Robert J. Fenner, 86, a 1982 retiree with 25 years of service, died May 22. Fenner was a U.S. Navy Veteran of World War II who began his NASA career in the Contract and Construction Unit of the Plants Services Division in 1961. There he served as the contractor coordinator for the Buildings and Grounds Branch. Fenner retired as head of the Maintenance Section, Facilities Operations and Maintenance Division.

Alan D. "Hap" Johnson, 94, a 1974 retiree with 30 years of service, died June 11. Johnson was director of Plum Brook Station (PBS) from 1961 to 1974. He previously served as chief of the Reactor Operations Branch, which oversaw design and operations for the PBS Reactor Facility. He supported the "Lewis Unitary Plan Activity" responsible for design and construction of the 10- by 10-Foot Supersonic Wind Tunnel at Lewis Field. Johnson served in the Army Medical Corps during World War II.

Vincent R. Lalli, 82, a 2004 retiree with 43 years of service, died July 8. Lalli was a product assurance manager in Glenn's Safety Assurance Office, responsible for ensuring safe operation of electronic hardware and software in aeronautic and space flight systems. Lalli wrote more than 50 technical papers and co-authored the "Reliability Home Study Course for the Engineer." He received numerous special achievement awards and earned a patent. Lalli was an active member of the Institute of Electrical and Electronic Engineering and Glenn's Speakers Bureau.

Eiter Reyes, 60, a 2010 retiree with 34 years of service, died April 4. Reyes was a U.S.Army Reservist and Veteran of Operation Desert Shield/Desert Storm. Early in his career, Reyes served as an avionics technician in the Aircraft Maintenance Branch. He supported several major in-flight tests on the NASA Learjet to calibrate and improve icing research techniques, telecommunications and shuttle landing automation. Prior to retiring, he was an equipment specialist in the Instrumentation Branch.

Calendar

RETIRED WOMEN'S LUNCHEON: The NASA Retired Women's Luncheon is Thursday, Aug. 21, at 1 p.m. at Mapleside Farms Orchard House Restaurant, 262 Pearl Rd.,Brunswick. Luncheons are held February, May, August and November. All are welcome. Please confirm your reservation by calling Gerry Ziemba, 330-273-4850.

FEDERAL FOOD DRIVE: NASA Glenn's 2014 Feds Feeds Families Food Drive runs through Aug. 22. Donation boxes are located throughout Lewis Field and Plum Brook Station POC: Andrea Bonesteel (Lewis Field), 3-2059, and Geneva Biglin (Plum Brook), 4-3344.

IFPTE LOCAL 28, LESA MEETING: LESA will hold its next membership meeting Wednesday, Sept. 10, noon, at Glenn's Employee Center's Small Dining Room.

ACTS PICNIC SET: Celebrate the 21st anniversary of the Advanced Communications Technology Satellite (ACTS) during a picnic on Friday, Sept. 12, 11:30 a.m. to 1:00 p.m. at the Lewis Field Picnic Grounds. Cost is $5. Retirees are welcome! Contact Kathleen Kelley, 216-433-5180 or Lesha Zvosec, 216-433-3401.

SEPTEMBER PUBLIC TOUR: The next Saturday tour, Sept. 13, will highlight The Telescience Support Center. Tours are open to U.S. citizens and lawful permanent residents. Space is limited and reservations are required for admission. To register, call 216-433-9653 or send an email to sean.r.delaney-gesing@nasa.gov. For more information and a complete schedule of Glenn's tours, visit http://www. nasa.gov/centers/glenn/events/tours.html.

SAFETY AND HEALTH AWARENESS: Mark your calendar for NASA Glenn's annual Safety and Health Awareness Day on Sept. 17. More information will be forthcoming in the September *AeroSpace Frontiers* and *Today@Glenn.* POC: Jim Smith, 3-2085.

KNOWLEDGE MANAGEMENT WEBSITE: A new website devoted to informing NASA Glenn civil servants and contractors about Knowledge Management requirements and processes at the Center is now available. To access the new site, which includes easy access to Glenn's collected lessons learned, a Media Library where users can find presentations, videos, policy documents, trade studies and link to other knowledge repositories, visit https://www.grc.nasa.gov/km/.

Emergency and Inclement Weather Lines
Lewis Field: 216-433-9328 (WEAT)
Plum Brook Station: 419-621-3333

Connect with Glenn

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AeroSpace Frontiers is an official publication of Glenn Research Center, National Aeronautics and Space Administration. It is published the second Friday of each month by the Office of Communications & External Relations in the interest of the Glenn workforce, retirees, government officials, business leaders and the general public. Submit short articles and calendar items via e-mail to the editor: doreen.b.zudell@nasa.gov or 216–433–5317.

September 2014 issue copy deadline: Aug. 22, noon

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Read AeroSpace Frontiers online at http://aerospacefrontiers.nasa.gov

NASA Outreach Gets Around

NASA Glenn's exhibit team and center staff brought the excitement of aeronautics and space exploration to five venues between July 11 and 20. From the top, clockwise: Hundreds visit NASA's Journey To Tomorrow trailer at the 45th annual Three Rivers Festival, Ft. Wayne, Ind.; Tom Sutliff staffs a NASA exhibit at the Blossom Music Center Sci-Fi Tribute, Cuyahoga Falls; Picture Yourself as an Astronaut is a popular STEM activity at the Macy's Kids, Cultures, Critters and Crafts Festival, Cincinnati, Ohio; John Oldham and Katie Carver interact at the Angola Balloons Aloft event, Angola, Ind.; Dennis Stocker conducts a microgravity demonstration at the Summer Moon Festival, Wapakoneta, Ohio, celebrating Neil Armstrong and the 45th anniversary of the Apollo 11 mission.

—By S. Jenise Veris


Photo by Mack Thomas

Photo by David DeFelice


Photo by Carlos Gomez


Photo by Orlando Thompson


Photo by Orlando Thompson