A Hybrid Wing Body model being tested in Langley's 14-by-22-Foot Subsonic Tunnel. The engines are on the top of the airplane to block noise to the ground. The model is mounted upside down, so the microphone array—the large red disk—can easily measure the noise as it would be heard by people on the ground. The microphone array was moved to different locations in the test section to simulate an airplane flying overhead.
Welcome to the 2013 edition of our annual report on NASA Langley Research Center’s accomplishments in the past year, and our plans for the future.

Like most federal agencies, we had some unique challenges due to sequestration and the government shutdown, but are working hard to minimize impacts while continuing our groundbreaking research and technology development.

Our work in space exploration and technology development continues to produce advances that will help NASA build and send robots and humans beyond Earth orbit—to destinations including an asteroid and eventually Mars.

Langley is helping advance designs for expanded launch capabilities, developing next-generation deployable space structures for larger solar arrays, and partnering with commercial companies to provide analysis and testing for the latest class of spacecraft.

We’re also working to speed the process of bringing manufacturing technologies to market, including additive manufacturing. We took a big step in that process in November when Langley became the first federal partner in the Commonwealth Center for Advanced Manufacturing, a consortium of manufacturers and universities based near Richmond, Va.

In aeronautics, Langley continues to work on technologies that will make commercial flight safer, cleaner and more efficient. We’re working to reduce aircraft noise around airports, boost fuel efficiency, relieve air-travel congestion in flight and on the ground, and are evaluating new aircraft designs in our labs and wind tunnels.

One experiment involves powering airplanes with cleaner alternative fuels—such as camelina plant oil, which we tested on a NASA DC-8 last summer. NASA has been evaluating bio-created kerosene that can be blended with jet fuel for use as a petroleum substitute to reduce harmful exhaust.

And our scientists are learning more about how planetary change affects people, from air travel to public health to the global economy. Langley researchers are conducting experiments from the land, sea, air and space to understand the atmospheric effects from volcanoes, industrial pollution, and changes in Earth’s temperature.

One airborne science mission measured air pollution in the San Joaquin Valley of central California and in the Houston region using several NASA aircraft equipped with scientific instruments. The mission, which will continue this year, is aimed at improving the ability of satellites to better observe and understand air quality in the lowest part of the atmosphere—where we work and live.

I invite you to browse these pages and learn more about all that NASA Langley has been doing.

— Lesa B. Roe
Center Director
Leading the Next Phase of Space Exploration

Langley researchers are helping to lead the nation into the next phase of space exploration. From helping to advance designs for expanded launch capabilities, to developing next-generation solar arrays, to partnering with commercial companies to provide analysis and testing for the latest class of spacecraft, the center is on the forefront of expanding the nation’s space exploration capabilities.

Developing and Maturing Future Space Technologies

In 2013, Langley joined the Commonwealth Center for Advanced Manufacturing (CCAM) as its first government member. Langley’s expertise, combined with the manufacturing capabilities of CCAM’s members, will speed the process of bringing advanced manufacturing technologies to market.

Langley engineers in collaboration with NASA’s Glenn Research Center are developing lighter, stronger and more compact solar arrays that can operate in a much harsher radiation environment than those currently used on commercial satellites. These new arrays could be used for electric propulsion on future near- and deep-space missions.

Langley also co-leads the aerosciences effort for the Low-Density Supersonic Decelerator Project flight dynamics test, which will launch the first of four planned flight tests in 2014. Center engineers have maintained and delivered the end-to-end aerodynamic database used in flight dynamics simulations to predict vehicle performance from release to splashdown.

In addition, Langley has been working on technology to allow spacecraft to safely land on the moon, Mars and even an asteroid, in potentially hazardous terrain areas with Autonomous Landing Hazard Avoidance Technology (ALHAT). Led by Johnson Space Center in Houston and supported by Langley and the Jet Propulsion Laboratory in California, ALHAT provides a planetary lander the ability to land precisely and safely on a surface while detecting any dangerous obstacles such as rocks, holes and slopes.

Assisting Commercial Space Development

Langley has conducted numerous wind tunnel tests, simulations and analyses to help commercial companies validate designs of their next generation of spacecraft to transport crew and cargo to the ISS. The center is providing essential design data to address critical challenge areas such as aerodynamics, aerothermodynamics, environmental loads, and controls. NASA astronauts also conducted landing simulations of Sierra Nevada Corporation’s Dream Chaser vehicle in the center’s Cockpit Motion Facility.

Water Recovery a Step Toward Launch

With the U.S. Navy’s well deck ship U.S.S. Arlington stationed against its pier at Naval Station Norfolk in Virginia, divers in small boats approached a test version of NASA’s Orion crew module. As part of a deliberative process, the divers attached towlines and led the capsule to a flooded well deck.

The stationary recovery test is helping to ensure that when Orion returns from deep-space missions and splashes down in the Pacific Ocean, the methods used to recover the spacecraft and obtain critical heat shield data are sound.

“Today marks a significant milestone in the Navy’s partnership with NASA and the Orion Human Space Flight Program,” said Navy Commander Bret Moyes, Future Plans Branch chief, U.S. Fleet. “The Navy is excited to support NASA’s continuing mission of space exploration. Our unique capabilities make us an ideal partner for NASA in the recovery of astronauts in the 21st Century—just as we did nearly a half century ago in support of America’s quest to put a man on the moon.”

The Navy and NASA collaboration under the Coordinate recovery test will be applied to the recovery of the Exploration Flight Test (EFT)-1 in September 2014. Langley’s Launch Abort System project was responsible for delivering an active jettison motor, forward interstage, and abort and attitude control motor inert simulators for EFT-1. Langley also assisted with developing and testing flight instrumentation for the EFT-1 heat shield. EFT-1 will be Orion’s first mission, which will send an uncrewed spacecraft 3,600 miles into Earth’s orbit. As part of the test flight, Orion will return to Earth at a speed of approximately 20,000 mph for a splashdown in the Pacific Ocean.

The flight test will provide engineers with critical data about Orion’s heat shield, flight systems and capabilities to validate designs of the spacecraft before it begins carrying humans to new destinations in the solar system, including an asteroid and Mars.

EFT-1 will launch from NASA’s Kennedy Space Center in Florida and splash down off the Baja Coast on the same day. For EFT-1, the recovery ship and team will be in the splashdown zone at the time of launch.
Creating Friendlier Skies and Faster Airplanes

Langley has a long history of partnering with the private and public sectors to advance aeronautics research. Such collaboration continues to focus on ways to reduce aircraft noise around airports, and is assessing how to boost aircraft fuel efficiency, evaluating new airplane designs, and creating new ways of relieving congestion in flight and on the ground.

The center’s aeronautical research included working with the U.S. Army on helicopter rotor aerodynamics and fuselage drag reduction to increase flight speed and hover performance, and testing with the U.S. Air Force to explore engine health monitoring and human factors. In addition, unmanned aerial vehicle technologies were investigated to extend operational endurance and payload capabilities.

Earlier in the year, NASA also selected eight large-scale integrated technology demonstrations to advance concepts and technologies to ensure that future air travelers fly in quieter, greener and more fuel-efficient aircraft. The demonstrations are part of the agency’s Environmentally Responsible Aviation (ERA) Project, which conducts many of its studies at the Center.

Reducing Environmental Impact

Concentrating on aircraft concepts and technologies to reduce the impact of aviation on the environment over the next 30 years, the ERA Project’s work will focus on five areas: aircraft drag reduction through innovative flow control concepts; weight reduction from advanced composite materials; fuel and noise reduction from advanced engines; emissions reductions from improved engine combustors; and fuel consumption and community noise reduction through innovative airframe and engine integration designs.

Langley is also providing extensive materials and acoustic modeling in support of development of the futuristic Hybrid Wing Body (HWB) commercial airliner concept, as well as vital wind tunnel testing to aerodynamically validate the HWB concept.

The latest efforts include an acoustic investigation conducted in a wind tunnel aimed at alleviating excessive aircraft noise generated by components upon landing approach, as well as routine operations near airports. Wind-tunnel investigations were also conducted to investigate the validity of new quiet-flap and landing gear concepts designed to decrease excessive aircraft noise.

In addition, Langley is working with industry to develop technologies that would allow environmentally friendly, efficient passenger flight above the speed of sound. That work includes trying to reduce, for both commercial airliners and fighter jets, the sonic booms created by aircraft flying supersonically.

Powering Airplanes with Camelina Plant Oil

In Langley’s hangar, Bruce Anderson stood between NASA’s HU-25C Guardian airplane and a group of reporters as he explained a series of recently completed flights.

“We’re interested in differences caused by different fuels, as well as just trying to understand better the physics and the chemistry of exhaust plumes,” said Anderson, project scientist for the ACCESS (Alternative Fuel Effects on Contrails and Cruise Emissions) experiment.

The experiment involved flying a NASA Dryden Flight Research Center DC-8 airplane as high as 39,000 feet while Langley’s instrumented HU-25C Guardian trailed behind at distances ranging from 300 feet to more than 10 miles. “This is kind of a unique experiment,” Anderson said. “You don’t often get that close to another aircraft.”

During the flights, the DC-8’s four CFM56 engines were powered by conventional JP-8 jet fuel or a 50-50 blend of JP-8 and an alternative fuel of hydroprocessed esters and fatty acids produced from camelina plant oil. More than a dozen instruments mounted on the Guardian jet characterized the soot, gases and ice particles streaming from the DC-8.

As Anderson explained, the FAA and other governing bodies have certified commercial airlines to fly using 50-50 fuel blends. NASA has been evaluating bio-created kerosene that can be blended with jet fuel to be used in the near-term as an alternative to petroleum.

“NASA’s focus is renewable fuel, such as camelina or fuel from algae,” Anderson said. It’s been 17 years since this type of flight experiment took place.

“A kind of unique experiment. You don’t often get that close to another aircraft.”

— NASA Scientist Bruce Anderson

“We had much better instruments this time and some of the questions have changed,” Anderson said. “People know more about the atmosphere and about how radiation is transmitted through the atmosphere.”

A second phase of ACCESS flights is planned for 2014. They will capitalize on lessons learned from the 2013 flights and include a more extensive set of measurements.
Space Satellite is Goal of Pollution Flights

If you want to understand air pollution, sometimes you’ve just got to get right in the middle of it. A multi-year airborne science mission did just that twice this year. Two NASA aircraft equipped with scientific instruments flew repeatedly over the San Joaquin Valley of Central California, and then over the Houston area.

The aircraft were part of a five-year NASA study called DISCOVER-AQ, which stands for Deriving Information on Surface conditions from Column and Vertically Resolved Observations Relevant to Air Quality. Researchers are working to improve the ability of satellites to consistently observe air quality in the lowest part of the atmosphere. If scientists can better observe pollution from space, they would be able to make better air quality forecasts and more accurately determine where pollution is coming from and why emissions vary.

A fundamental challenge for space-based instruments monitoring air quality is to distinguish between pollution high in the atmosphere and pollution near the surface where people live. DISCOVER-AQ took measurements from aircraft in combination with ground-based monitoring sites to help scientists better understand how to observe ground-level pollution from space.

“DISCOVER-AQ is collecting data that will prepare us to make better observations from space, as well as determine the best mix of observations to have at the surface when we have new satellite instruments in geostationary orbit,” said James Crawford, the mission’s principal investigator at NASA’s Langley Research Center in Hampton, Va. “NASA is planning to launch such an instrument, called TEMPO, in 2019.”

Because many countries, including the United States, have large gaps in ground-based networks of air pollution monitors, experts hope satellites can provide a more complete geographic perspective on the distribution of pollutants.

A fleet of Earth-observing satellites, called the Afternoon Constellation or “A-train,” passed over the DISCOVER-AQ study areas daily. The data is giving scientists the opportunity to compare the view from space with that from the ground and aircraft.

“The A-Trains satellites have been useful in giving us a broader view of air pollution than we’ve ever had before,” said Kenneth Pickering, DISCOVER-AQ’s project scientist at NASA’s Goddard Space Flight Center in Greenbelt, Md. “DISCOVER-AQ will help scientists interpret that data to improve air quality analysis and regional air quality models.”

The airplanes used included a four-engine P-3B turboprop plane from NASA’s Wallops Flight Facility in Wallops Island, Va., carrying eight instruments and a two-engine B200 King Air aircraft from NASA Langley with two instruments.

The 117-foot-long P-3B sampled the air as it spiraled between altitudes from 15,000 feet to as low as 1,000 feet over the ground sites. The smaller B200 King Air looked down at the surface, much like a satellite, and measure particulate and gaseous air pollution.

A World-Renowned Climate Record

A series of instruments developed by Langley for NASA’s Earth Observing System (EOS)—known collectively as the Clouds and the Earth’s Radiant Energy System mission, or CERES—are a world-renowned source of information about global climate. To date, the CERES mission has launched six instruments on four satellites. Including the predecessor mission known as ERBE—short for Earth Radiation Budget Experiment—a combined 28 years of data have been archived: the longest and best record of Earth’s energy balance.

Understanding climate change requires both long-term and uninterrupted measurements. Because data continuity is crucial, in 2013 Langley built and tested the next CERES instrument for delivery in 2014, and is infusing work on the next-generation radiation budget instrument scheduled for launch in 2018.

The Climate Absolute Radiance and Refractivity Observatory (CLARREO), now in the early stages of planning and development, will detect climate trends, providing accurate, credible and tested climate data to inform decision-makers as society adapts to and mitigates the effects of climate change.

Eying Climate from Space

Langley’s CALIPSO mission—short for Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations—to better understand the role of clouds and aerosols in climate, weather, and air quality, recently marked its seventh year of operation. Thanks to CALIPSO, researchers can now identify what aerosols are made of, and at what atmospheric altitude they occur. By also pinpointing where aerosols originate and how they’re transported, this new knowledge helps to refine and improve computerized climate models.

So far, more than 900 scientific papers have been published using CALIPSO data.

Langley’s Stratospheric Aerosol and Gas Experiment (SAGE) III mission on the International Space Station is on track for launch in 2015, continuing a long legacy of measuring ozone, a gas in the upper atmosphere that acts as Earth’s sunscreen. This past year, the SAGE III team completed SAGE III hardware refurbishment, receiving permission to proceed to the next phase.

In August, Langley researchers participated in a mission to study how air pollution and natural emissions pushed high into the atmosphere by large storms that affect atmospheric composition and climate. Another mission to improve the use of satellites to monitor air quality for public health and environmental benefit conducted two 2013 campaigns: one in California’s San Joaquin Valley in January and February, and another in Houston, Texas in September.

Researchers in Langley’s Science Directorate are passionate about understanding our home planet, especially Earth’s atmosphere and climate. In learning more about how planetary change affects people, from air travel to public health to the global economy, they conduct research from the land, sea, air and space to understand the atmospheric effects caused by volcanic eruptions, industrial pollution, changes in the planet’s energy balance and other events.

In developing instruments and measurement techniques, Langley has amassed one of the world’s most comprehensive collections of atmospheric data, about 50 times the total holdings of the Library of Congress. This information is housed in Langley’s Atmospheric Science Data Center, and serves 130,000 customers in 160 countries.
Helping to Reshape Technology’s Future

To increase competitiveness, create jobs and improve the balance of trade, Langley helps to transfer NASA-developed technology and expertise to U.S. industry. That’s why Langley’s Office of Strategic Analysis, Communications and Business Development routinely reaches out to collaborate and partner.

Langley’s online Technology Gateway is an indispensable resource for companies looking for answers to technology challenges and problems. Four main technology categories—advanced materials, aerospace applications, sensors and detectors, and software—are listed, with a detailed description of the licensing opportunities available from Langley in these and other areas.

By drawing on existing technology resources, collaboration reduces private-sector research and development costs. Collaboration with Langley can help to leverage a company’s technical capabilities, expertise and facilities, harnessing different perspectives to accelerate solutions to technical challenges. The end result: the creation of new products and new technologies.

A 2013 Success Story

When the U.S. Navy was designing a jet engine simulator for jet engine plume studies, stainless steel flame holders used in testing would quickly burn up or melt. This year, two Langley researchers created the quick-change ceramic flame holder, which can withstand temperatures around 4,000º Fahrenheit, a two-fold improvement in heat tolerance.

Adding a twist-lock mounting mechanism to the steel burner translates to easy replacement: no tools are required. The device also saves on maintenance costs and improves safety with better flame control.

The Navy adapted a larger version of the ceramic flame holder for its engine simulations. Another variant is being used simulate a solid rocket launch abort motor in testing of NASA’s Launch Abort System. In addition, the technology could find use for metals forging, in casting furnaces, and in pottery kilns.

Wireless Sensors and Liquid Crystals

Wireless sensors developed at Langley that can work without batteries or receivers and can be placed virtually anywhere recently won a 100 Top Innovation Award presented by R&D Magazine. Now, the sensors are being developed commercially.

In one licensing agreement, Alabama-based GLSEQ, LLC will use Langley wireless sensors for instrumentation and control systems for nuclear power plants. Another venture, a partially exclusive license agreement with Kelvin International Corporation in nearby Newport News, Virginia may result in built-in, liquid-level, non-contact sensors for bio-storage containers.

This year, North Carolina firm Allotropica Technologies, Inc. received an exclusive license for development of Langley’s liquid crystal polymer technologies. The company plans to make liquid crystal polymer materials for use as components in high-temperature, flame-resistant foams, coatings and composites.

Nanotube Commercialization

A 2013 joint venture involving Langley, the Thomas Jefferson National Accelerator Facility and the National Institute for Aerospace that led to the creation of fibril boron nitride nanotubes gained momentum in 2013 with construction of the world’s first commercial factory dedicated to the manufacture of fibril boron nitride nanotubes.

A structurally similar ceramic analog to carbon nanotubes, these very strong and versatile submicroscopic cylinders may find wide use in aerospace applications. They may also be incorporated as components of next-generation body armor, thin coatings, batteries, electrical insulation, fire-retardant cabling, and sensors. Biomedical uses may include implants for dentistry, and materials to aid in nerve and bone-tissue regeneration.

Debugging Research

Researcher John Gardner lies inside the Basic Aerodynamics Research Tunnel, or BART, to prep the leading edge of a scale model wing for a blast of bugs from the tunnel’s bug “gun.”

Dream Chasing

Bruce Jackson, left, an engineer at Langley’s Cockpit Motion Facility, briefs astronauts Rick Walheim and Gregory Johnson as they evaluate a landing simulation for Sierra Nevada Corporation’s Dream Chaser.

NASA in Virginia

Four major launches were made this year from NASA’s Wallops Flight Facility on the Eastern Shore of Virginia, and a fifth was planned for mid December. The launches illustrate the impact of the Mid-Atlantic Regional Spaceport at Wallops and the increasing involvement of private companies in the exploration and use of space. Among the launches, one was the first ever from Virginia to the moon. Another was the first launch from Virginia to the International Space Station.
Langley is developing space exploration concepts like the Hypersonic Inflatable Aerodynamic Decelerator shown here. It would serve as a heat shield and parachute for spacecraft entering a planet’s atmosphere. The inflatable is made of materials layered together to withstand temperatures up to 2,300 degrees Fahrenheit.
Inspiring with Outreach and Education

Like all NASA field centers, NASA Langley reaches out through education and outreach programs and events. These showcase Langley’s role in space exploration, science and flight, and teach and encourage with hands-on activities and lessons.

High school and college students work with NASA mentors, who help them conduct research and develop technology applications that have far-reaching impact. Teachers participate in workshops that give them the tools to teach. Some teachers spend time working for NASA to develop or run programs for students. Even the youngest benefit from classroom visits by Langley employees and through events designed to engage and inspire the next generation of explorers.

NASA’s Associate Administrator for Education, former astronaut Leland Melvin, visited the Virginia 529 Kids Zone at the Richmond International Raceway, where he participated in two NASA engineering design challenges and interacted with the Rockets 2 Racecars’ visiting teachers.

Astronaut, Serena Aunon spoke to students of The VALHEN Hispanic College Institute at Virginia State University located in Petersburg. Serena was selected as a NASA astronaut in 2009 and completed astronaut candidacy training in 2011 and serves as a flight surgeon.

Near the end of the final 2013 VASTS session, former program manager Amber Ayers-DiHart said the skills students learn during the VASTS program could help to put them “ahead of the game.”

Langley employees Pam Stacy and Nancy Hornung have a little fun organizing food donations for the Feds Feeds Families campaign.

NASA Astronaut, Randy Bresnik came to Virginia Air and Space Center in Hampton and spoke to the children attending the museum’s summer camp. “How to be an Astronaut.” He gave a brief talk about being an astronaut and then fielded questions from the youth.

Students in the NASA Aeronautics Academy at Langley assemble under a Langley Air Force Base B-52. College students in engineering and science disciplines work together in the program as research associates to solve real aeronautics problems. They continue to collaborate after they leave Langley to produce technical papers and present their work at professional conferences.

Students interns designed and built an unmanned aerial vehicle that one day may be used to pinpoint wildfire hotspots and lead firefighters to them.

NASA engineer David Way talks with kids at the Virginia Air & Space Center during an event celebrating the landing of the Curiosity rover on Mars. Way and a Langley team played a critical role in the landing.

An inspired 529 Kids Zone student team shares their ideas with Langley employees during a feedback session on the project.

Near the end of the final 2013 VASTS session, former program manager Amber Ayers-DiHart said the skills students learn during the VASTS program could help to put them “ahead of the game.”

Langley enginee David Way talks with kids at the Virginia Air & Space Center during an event celebrating the landing of the Curiosity rover on Mars. Way and a Langley team played a critical role in the landing.

Students in Langley’s Virginia Aerospace Science and Technology Scholars (VASTS) program participate in a Mission Design Review Concept Panel. About 180 students worked individually and together to plan a mission to Mars.

NASA Astronaut, Randy Bresnik came to Virginia Air and Space Center in Hampton and spoke to the children attending the museum’s summer camp. “How to be an Astronaut.” He gave a brief talk about being an astronaut and then fielded questions from the youth.

Students in the NASA Aeronautics Academy at Langley assemble under a Langley Air Force Base B-52. College students in engineering and science disciplines work together in the program as research associates to solve real aeronautics problems. They continue to collaborate after they leave Langley to produce technical papers and present their work at professional conferences.
A Diverse Workforce Drives Langley Success

Diversity is key to ensuring a large organization like NASA Langley succeeds. Langley’s workforce is made up of scientists, engineers, technicians, administrative professionals, and clerical staff with varying degrees of education, from high school degrees to multiple doctorates.

In 2013, 1,895 civil service and 1,538 contract employees supported NASA Langley.

Education Distribution

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<thead>
<tr>
<th>Education Level</th>
<th>Percentage</th>
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<tr>
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<tr>
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<td>Associates, More Than Two Years College</td>
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<tr>
<td>High School, Advanced Study Certificate, Some College</td>
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Occupation Distribution

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<tr>
<td>Administrative Professional</td>
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<td>Technician</td>
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<td>63%</td>
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Before Bill Leath heard the squealing tires, it was just an ordinary Wednesday morning.

He brewed a pot of coffee. He walked out front to grab the newspaper. Then he walked around back to check on his garden.

In his backyard, which overlooks Newmarket Creek in Hampton, Leath noticed something — probably an opossum — had dug up some cantaloupe rinds from his compost pile. Not wanting the rinds to attract flies, he set about reburying them.

And that’s when his morning went from ordinary to extraordinary.

“I just looked up because I heard the tires squealing,” he said.

Leath, a 59-year old Northrop Grumman aerospace engineer working for the Air Traffic Operations Lab at NASA’s Langley Research Center, then watched as a car traveling south on LaSalle Avenue launched off the road and plunged upside-down and nose first into the creek.

He was stunned. It took his brain a few startled seconds to process what he’d just seen. Then it clicked: a person was trapped in that car.

As he ran he could hear a woman calling for help. By the time he got to the water’s edge, the car was so deep he couldn’t see anything more than the trunk.

“He looked at me like I was crazy, like, ‘Why are you swimming that way?”’ Leath said.

Then Ehret saw the car and jumped in to help.

Leath had been swimming for about a minute when he looked up. Just a few feet in front of him, the driver of the car, who police would later identify as Hampton resident Dorothea Allen-Riley, was floating face down in the water.

He grabbed Allen-Riley and pulled her close. Water spilled out of her mouth. She took a huge breath.

“I thought, thank God she’s still alive,” he said.

Now in about 8 to 10 feet of murky creek water, Leath and Ehret each took one of Allen-Riley’s arms and swam back to shore with her, being careful to keep her head raised.

As he ran he could hear a woman calling for help. By the time he got to the water’s edge, the car was so deep he couldn’t see anything more than the trunk.

Ehret looked up at his seven-year-old son, who was waiting in the backyard with a phone, and told him to call 911. Help arrived quickly — police first, then medics. Thinking the morning’s excitement was finally over, Leath went home to show and get ready for work—but work would have to wait.

“When I could get out the door the press descended on me like the 17-year cicadas,” he said. “I got hit by all three TV channels and the Daily Press.”

Though he says he’s “not overly religious,” Leath can’t shake the feeling that “someone” was watching over Allen-Riley that May morning. To him, it’s strange that he happened to be there, that the swim was relatively easy.

Leath, a former lifeguard and competitive swimmer, dove in. Back on shore, Leath’s neighbor, Jake Ehret, called out to him. Ehret had seen Leath run through his backyard and thought he might be chasing a burglar. Out of breath, Leath flipped over onto his back and shouted to Ehret for help.

“I think he thought I was the one in trouble,” Leath said.

As the swim was relatively easy, Ehret each took one of Allen-Riley’s arms and swam back to shore with her, being careful to keep her head raised.

“Before I could get out the door the press descended on me like the 17-year cicadas,” he said. “I got hit by all three TV channels and the Daily Press.”

Ehret looked up at his seven-year-old son, who was waiting in the backyard with a phone, and told him to call 911. Help arrived quickly — police first, then medics. Thinking the morning’s excitement was finally over, Leath went home to shower and get ready for work—but work would have to wait.

“Yeah, that opossum,” he said. “It was all because of him.”
ECONOMICS


NASA Wallops Generated the Following Economic Impact:
- In the U.S., the economic impact was $829.3 million that supported 16,500 jobs.
- In Hampton Roads, the economic impact was $798 million that supported 7,481 jobs.
- In Virginia, the economic impact was $267.5 million that supported 6,798 jobs.

In Fiscal 2013, NASA Langley Generated the Following Economic Impacts:
- In Virginia, the economic impact was $2.1 billion that supported 16,500 jobs.
- In Hampton Roads, the economic impact was $798 million that supported 7,481 jobs.


Top Obligations to Business Contractors

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<td>Lockheed Martin Corp.</td>
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<td>Saab Sensis Corp.</td>
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<td>Dyncorp International LLC</td>
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<td>Alltech 350 LLC</td>
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<tr>
<td>Modern Machine And Tool Company</td>
<td>$1,649,493</td>
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<td>Straughan Environmental Inc.</td>
<td>$1,530,019</td>
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</table>

Nonprofit & Educational Institutions

<table>
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<tr>
<th>Institution Name</th>
<th>Obligation Amount</th>
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</thead>
<tbody>
<tr>
<td>National Institute of Aerospace</td>
<td>$24,114,288</td>
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<tr>
<td>Regents of The University of Michigan</td>
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<tr>
<td>U.S. Army Corps of Engineers</td>
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<td>Public Building Service Office</td>
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<td>Pennsylvania State University</td>
<td>$2,408,723</td>
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<td>Georgia Tech Research Corp.</td>
<td>$2,319,796</td>
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<td>OSU Center for Innovation and Economics</td>
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<td>The Aerospace Corp.</td>
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<td>U.S. Dept. of the Air Force</td>
<td>$1,405,924</td>
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<td>Research Triangle Institute</td>
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<td>Smithsonian Institution</td>
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<td>University of Illinois</td>
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<td>University of Southern California</td>
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<td>Old Dominion University Research Foundation</td>
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<td>Christopher Newport University</td>
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<td>City of Newport News Va</td>
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<td>U.S. Department of the Army</td>
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<td>Ohio University</td>
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<td>University Corp. for Atmospheric Research</td>
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<td>University of Maryland Baltimore County</td>
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<td>Regents of the University of Minnesota</td>
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<td>The University of Iowa</td>
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<td>Judiciary Courts of the Commonwealth of Virginia</td>
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</tbody>
</table>

Key to Direct State Funding Levels

- $0 - $100,000
- $100,000 - $1 million
- $1 - $5 million
- $5 - $20 million
- $20 - $100 million
- + $100 million

Wallops Flight Facility

Langley Spending by State

Legend

- Virginia
- Alaska
- Idaho
- Michigan
- Iowa
- Maryland
- Massachusetts
- New Mexico
- Ohio
- Pennsylvania
- South Carolina
- Tennessee
- Texas
- Utah
- Wisconsin
- Dist of Columbia
- Virginia

Economic Impact of NASA in 2013

<table>
<thead>
<tr>
<th>Year</th>
<th>Dollars in Millions</th>
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</thead>
<tbody>
<tr>
<td>2009</td>
<td>$759</td>
</tr>
<tr>
<td>2010</td>
<td>$786</td>
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<tr>
<td>2011</td>
<td>$790</td>
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<tr>
<td>2012</td>
<td>$846</td>
</tr>
<tr>
<td>2013</td>
<td>$743</td>
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</tbody>
</table>
Crew Systems and Aviation Operations Branch, was selected Honorary Fellow of the Society of Allied Weight Engineers at the 21st Century. Eugene Morel, Dynamic Systems & Control Branch, received the Hampton Roads Section (HRS) AIAA Engineer of the Year award and was selected as the Peninsula Engineering Council Engineer of the Year. He also received the AIAA Mechanical & Control Flight Dynamics Award for 2013.

Hyun Jung Kim, of the National Institute of Aerospace (NAI) and the Advanced Materials & Processing Branch, received the 2013 Daniel A. Mitchelle Young Engineer of the Year award by the Society of Allied Weight Engineers for his work with the National Space Club. The Virginia Department of Education & Research Center. continued from Previous page


The Virginia Department of Environmental Quality selected NASA Langley as a 2012 Sustainability Partner of the Virginia Governor’s Environmental Excellence Bronze Award for the Biomass Mass Balance Program.

NASA Langley Research Center was awarded the Hampton Roads Science & Technology Council’s “Science & Technology of the Year” Award at Langley was selected by the White House and NASA HQ 2012 Presidential Inauguration Parade on January 21.

NASA Langley received the Virginia Governor’s Environmental Excellence Bronze Award for the Biomass Mass Balance Program.

The Virginia Department of Environmental Quality selected NASA Langley as a 2012 Sustainability Partner of the Virginia Governor’s Environmental Excellence Bronze Award for the Biomass Mass Balance Program.

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The Virginia Air & Space Center

The Virginia Air & Space Center in Hampton is NASA Langley’s official visitor center. It features interactive aviation exhibits spanning 100 years of flight, more than 30 historic aircraft, a hands-on space gallery, unique space flight artifacts, and more. While at the air and space center, you can launch a rocket, pilot a space shuttle, program Mars rovers for a mission, become an air-traffic controller, fly an airplane, climb aboard a WWII bomber and experience a 3D IMAX film. Also on display is the Apollo 12 Command Module that went to the moon, a Mars meteorite, a three-billion-year-old moon rock, a DC-9 passenger jet and a replica 1903 Wright Flyer.

For more information, go to http://vasc.org
Passing of former Langley Directors observed

We observed the passing of two of Langley’s former center directors this year. Their careers spanned almost the entire Space Age, and their achievements are a tribute to their talent, professionalism and dedication.

Donald Hearth — During his tenure as Director from 1975–1984, Hearth oversaw support for shuttle missions and research into the development of composite materials for commercial and military aircraft. He also spent a year serving as the agency’s acting deputy administrator before retiring in 1985. He was 85.

Paul Holloway — In 1960 Holloway began his career as an aerospace research engineer at Langley, and in 1991 he was selected as Director and retired in 1996. He represented Langley on space station, shuttle and space transportation committees, and served three high-level tours of duty at NASA Headquarters. An expert in hypersonic aerodynamics, he led a team of more than 300 people from across the agency on the development of the space shuttle during the 1970s. He was 75.

Second man to orbit Earth dies

Scott Carpenter, the second American astronaut in orbit, died Oct. 10, 2013. As one of the original Mercury astronauts, Carpenter “was in the first vanguard of our space program — the pioneers who set the tone for our nation’s pioneering efforts beyond Earth and accomplished so much for our nation,” NASA Administrator Charles Bolden said shortly after Carpenter’s death. Carpenter’s Aurora 7 capsule circled the Earth three times on May 24, 1962 during its four-hour, 54-minute flight. Because NASA Langley was the original home of the Mercury Project, Carpenter and the other Mercury astronauts trained here and lived in the area in the late 1950s. The M. Scott Carpenter Bridge on Armistead Avenue in Hampton, Va., is named after him in a tradition of naming local bridges after the “Original Seven” astronauts. Carpenter was 88.