

National Aeronautics and Space Administration



# Citizen Report

A look at the work and impact of the Dryden Flight Research Center for Fiscal Year 2012



ED12-0331-16

NASA/Carla Thomas

## Dryden Flight Research Center

# Citizen Report Fiscal Year 2012

## Introduction to the Dryden Flight Research Center

Dryden Flight Research Center, located on the western edge of California's Mojave Desert, has made many significant contributions to NASA's mission since the agency was established more than five decades ago.

Dryden's history dates to late 1946, when 13 engineers and technicians arrived at what is now Edwards Air Force Base from the National Advisory Committee for Aeronautics Langley Memorial Aeronautical Laboratory. Their goal was to prepare for the first supersonic research flights by the X-1 rocket plane in a joint NACA/U.S. Army Air Forces/Bell Aircraft program. The NACA was the predecessor organization of today's NASA.

Dryden continues to pioneer programs that contribute to aeronautics, technology development, reduced cost space access, human exploration and operations in space and Earth and space science. Dryden completes that work for 1.39 percent of NASA's budget, or \$252.9 million. Dryden's workforce consists of about 1,151 contractor and civil servant employees.



NASA

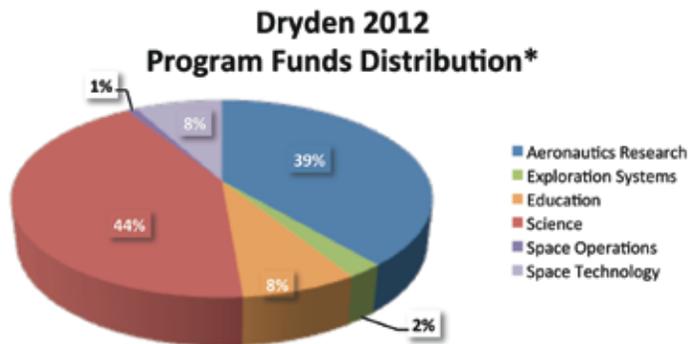
*The X-1E and Dryden's main administration Building 4800 are pictured.*

### Our Vision

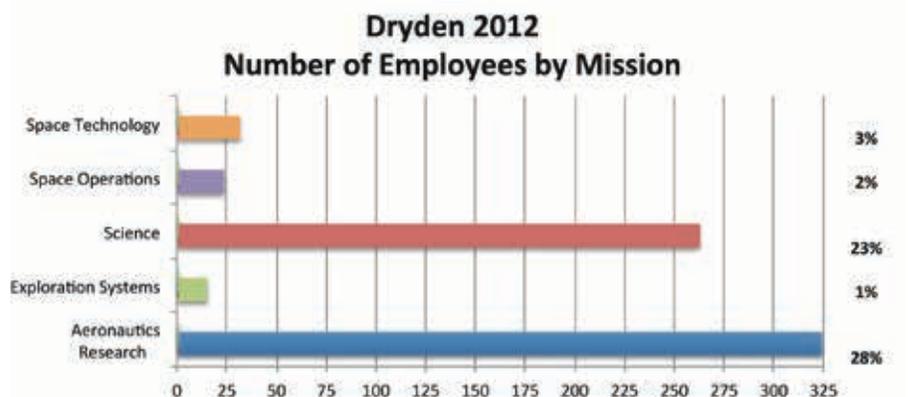
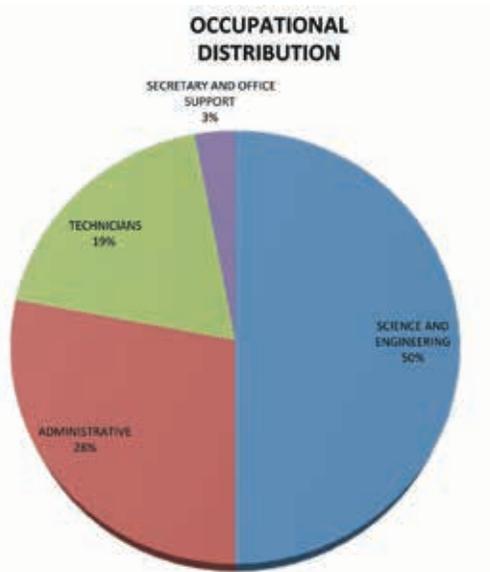
To fly what others only imagine

### Our Mission

Advancing technology and science through flight



\*Percentages based on total program budgets  
Chart includes all projects



# Aeronautics

NASA conducts cutting-edge research in traditional and emerging disciplines to help transform the nation's air transportation system, and in support of future aerospace vehicle development. NASA Dryden's world-class flight research capability is built on a tradition of expertise in aeronautical engineering and its core research disciplines, including aerodynamics, aero-acoustics, materials and structures, propulsion, dynamics and control, sensor and actuator technologies, advanced computational and mathematical techniques, and experimental measurement techniques.

Dryden helped advance the agency's overall mission of Earth and space science and aerospace technology research as it continued supporting NASA's key mission areas during 2012.

## X-48 Blended/Hybrid Wing Body

The remotely piloted "C" version of the X-48 Blended Wing Body sub-scale research aircraft successfully flew for the first time on Aug. 7. The new X-48C model was modified from its earlier X-48B configuration to evaluate the low-speed stability and control of a low-noise version of a proposed future Hybrid Wing Body aircraft design.

The project's 100th flight milestone occurred Oct. 30 when the X-48C made its seventh and eighth flights. Between 2007 and 2010, the aircraft, then in the X-48B configuration, made 92 flights. Designed by the Boeing Co. and built by Cranfield Aerospace Ltd. of the United Kingdom, the X-48 is flying in partnership with NASA.



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NASA/Carla Thomas

*The X-48C flew for the first time in 2012. The flights of the new configuration also marked flight 100 for the aircraft, the most research flights ever for a unmanned aircraft system.*

## Sonic Boom Research

In November, Dryden flew a series of low-supersonic, high-altitude flight profiles during the Farfield Investigation of No Boom Threshold, or FaINT, flight research project. The effort, involving several NASA centers, industry and university partners, gathered data to expand the collective knowledge of sonic boom propagation effects to provide the data necessary for engineers to design future low-boom supersonic aircraft. The overarching goal of NASA's sonic boom reduction research is to shrink the sonic boom "footprint" in order to make civil supersonic flight over land practical.



ED12-0356-161

NASA/Tom Tschida

*James Smolka and Jim Ross get ready to document a sonic boom flight.*

## Automatic Ground Collision Avoidance System

Dryden researchers successfully conducted flight tests of a miniature automatic ground collision avoidance system for



ED12-0172-11

NASA/Tom Tschida

*Several Remotely Operated Integrated Drone project team members secure the aircraft's single-piece wing.*

small, unmanned aircraft last May. During final test flights of the software integrated into an autopilot on the Dryden Remotely Operated Integrated Drone research aircraft, the smartphone-assisted system consistently commanded evasive maneuvers when it sensed the aircraft was getting too close to rocky, mountainous terrain or ridgelines and impact with the terrain was imminent.

## UAS in the NAS

On March 15, Dryden completed the first flights in the Unmanned Aircraft Systems in the National Airspace System project, using the unmanned MQ-9 Ikhana aircraft for evaluation of the Automatic Dependent Surveillance-Broadcast aircraft tracking system adapted for UAS. All aircraft operating in certain U.S. airspace must adopt ADS-B aircraft tracking technology by January 2020 in order to comply with Federal Aviation Administration regulations. The flight was the first time an unmanned aircraft as large as the MQ-9 had flown equipped with ADS-B. The initial flights checked out the system's capabilities in the "out" or transmit mode, while more recent flights evaluated the system's "in" or receive data mode and its ability to downlink information to the ground control station.



ED12-0082-01

NASA/Tony Landis

*Engineers and technicians check the Automatic Dependent Surveillance-Broadcast aircraft tracking system adapted for use with unmanned aircraft systems and researched on the Dryden Ikhana aircraft.*

# Science

Dryden's Science Mission Directorate provides unique or highly modified aircraft, flight operations for scientific data collection and the development of advanced aeronautical capability to support the NASA Earth Science and Astrophysics programs.

## Earth and Space Science

### HS3 Mission

The 2012 Hurricane and Severe Storm Sentinel, or HS3, mission in September saw a NASA Global Hawk aircraft fly



ED12-0266-37

NASA/Tom Tschida

*NASA's Goddard Space Flight Center developed the Cloud Physics Lidar mounted in a NASA Global Hawk. Goddard support scientist Patrick Selmer, left, and Northrop Grumman mechanics Steve Crowell, center, and Tom Ripley position the sensor that measured cloud structure and aerosols during a NASA study focusing on hurricane formation and intensity changes.*



NASA/Jefferson Beck

*Columbia University geophysicist Kirsty Tinto explains the science behind the gravimeter instrument to a group of visitors while returning from a NASA DC-8 survey of the Ronne Ice Shelf in Antarctica.*

from the agency's Wallops Flight Facility in Wallops Island, Va., to investigate the environment and cloud structure of hurricanes Leslie and Nadine in the Atlantic Ocean. This was the first deployment from Wallops for the Dryden-based aircraft, which flew more than 148 hours during six HS3 science flights.

### Operation IceBridge

Researchers with NASA's Operation IceBridge completed a five-week Antarctic field campaign this fall aboard the agency's DC-8

airborne science laboratory from Punta Arenas, Chile. From Oct. 12 to Nov. 8, researchers gathered valuable information on land and sea ice during 16 science missions over Antarctica. During this year's fourth Antarctic campaign, IceBridge scientists added to existing sea ice elevation data, surveyed new areas of the Antarctic ice sheet and reached out to students, teachers and the public.

## ER-2 Missions

NASA's high-altitude ER-2 aircraft flew a number of missions this year, including deployments to Iceland and the agency's Wallops Flight Facility for research using a new laser altimeter dubbed MABEL. The Multiple Altimeter Beam Experiment Lidar was developed at NASA's Goddard Space Flight Center to simulate a similar instrument planned for NASA's IceSat-2 satellite that is scheduled for launch in 2016.

## UAVSAR

The Uninhabited Aerial Vehicle Synthetic Aperture Radar, or UAVSAR, flies aboard NASA's C-20A aircraft. Missions in 2012 included glacier research of Iceland's ice caps; volcano studies in Hawaii, Alaska, Japan and in the Cascade Range in Oregon and Washington; landslide imaging in Colorado; soil moisture studies in the U.S. Midwestern states, and flights over earthquake faults in the Southwest.

## SOFIA Observatory

NASA's Stratospheric Observatory for Infrared Astronomy began checkout and validation flights in early December after



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NASA/Tom Tschida

NASA Dryden's C-20A research aircraft lifts off the Edwards Air Force Base runway with the unmanned air vehicle synthetic aperture radar, or UAVSAR, pod.



NASA/Tom Ryan

Dryden research pilot Tom Ryan snapped this self-portrait while flying NASA's ER-2.

undergoing major upgrades to its mission command and control system and avionics systems during most of the year. The flying observatory is slated to begin its Cycle 1 series of astronomical observations with its first-generation instruments in spring 2013.



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NASA Photo by Jim Ross

John Grunsfeld, associate administrator of NASA's Science Mission Directorate and a former space shuttle astronaut, left, and a telescope technician examine the framework supporting the 100-inch primary mirror in the telescope cavity of NASA's SOFIA flying observatory.

# Flight Opportunities Program

The Flight Opportunities Program is part of NASA's Office of the Chief Technologist. The office is responsible for advocating and advising on agency-wide technology policy and programs and maturing crosscutting technologies, or discoveries that are useful in a number of areas, to flight readiness status for future space missions.

The Office of the Chief Technologist, established in 2009, also is responsible for management of NASA's Space Technology programs. The chief technologist is responsible for developing and executing innovative technology partnerships, for technology transfer and commercial activities and development of collaboration models for NASA.

## Spaceflight Technology

### Flight Opportunities Program

NASA's Flight Opportunities Program sponsored the first successful free flight of a new control system for Masten Space Systems' Xombie suborbital vertical landing demonstrator on Feb. 2, 2012 at the Mojave Air and Space Port, Mojave, Calif. The flight used a new flight control system concept that will enable future demonstrations of landing technologies needed for exploration of planets and moons, as well as near-Earth objects, like asteroids. The Flight Opportunities program's mission is to oversee the integration and flight of a variety of technology payloads on commercial suborbital reusable vehicles near the boundary of space to help meet the agency's research and technology needs.



Photo courtesy of Draper Laboratory

*Masten Space Systems' Xombie rocket with Draper Laboratory's GENIE flight control system had its first untethered flight from the Mojave Air and Space Port, Calif.*

# Human Exploration and Operations

The Human Exploration and Operations Mission Directorate is responsible for the leadership and management of NASA space operations including human exploration in and beyond low Earth orbit. The directorate also oversees low-level requirements development, policy, and programmatic oversight. The International Space Station, currently orbiting the Earth with a crew of six, represents the NASA exploration activities in low Earth orbit.

Exploration beyond low Earth orbit includes the management of commercial space transportation, exploration systems development, human space flight capabilities, advanced exploration systems, and space life sciences research and applications. The directorate is similarly responsible for agency leadership and management of NASA space operations related to launch services, space transportation, and space communications in support of human and robotic exploration programs.

## Space Shuttle Endeavour's Final Journey

The highlight of the year was the stopover of space shuttle Endeavour and its modified NASA 747 Shuttle Carrier Aircraft Sept. 20 during the final ferry flight of a shuttle from the Kennedy Space Center to Los Angeles, where it was turned over to the California Science Center for museum exhibit.

Following an overnight stay at Dryden, the SCA and Endeavour saluted the communities of Palmdale, Lancaster, Rosamond and Mojave with low-level flyovers before heading north to Sacramento and the San Francisco Bay Area on its tour of California. More than two million people were estimated to have watched the SCA-Endeavour combo during low-altitude flyovers of famed landmarks in both Northern and Southern California, with extensive media coverage giving millions more the opportunity to watch the flyovers and the subsequent overland journey through Los Angeles to the science center museum three weeks later.

Dryden supported the science center's grand opening of the Endeavour exhibit on Oct. 30 and the related six-day SpaceFest. NASA had more than three-dozen exhibits, displays, and educational demonstrations honoring aeronautics and space exploration.



EC12-0316-078

NASA/Tom Tschida

*Media, social media and Dryden employees and family saw the NASA 747 Shuttle Carrier Aircraft with the Space Shuttle Endeavour on top when it landed at Edwards Air Force Base on Sept. 20. After a media event and viewing, the aircraft departed the next day for a flyover of California and a landing at the Los Angeles International Airport.*

# Economic Impact

## Dryden Flight Research Center is a big contributor

NASA has 10 centers across the nation that enable the agency to carry out its mission. Dryden is NASA's premier installation for aeronautical flight research for current and future aerospace vehicles. Dryden also plays a key role in NASA's development of next-generation access-to-space, reusable launch vehicles from commercial partners and Earth and space science research.

In past years, Dryden has employed hundreds of personnel in achieving the center's mission. In 2012, the center employed 1,151 people, about 554 civil servants and 597 private-sector contractors on or near the site.

A major source of U.S. economic output is generated from the procurements and expenditures made in support of NASA programs, including payroll, operating expenditures and construction totaling about \$252.9 million.

Dryden strives to maximize benefits produced by activities conducted at the center while minimizing costs. In addition to technical and social impacts derived through these activities, the total benefit of business Dryden conducts also includes a significant economic boost in the location it operates in and among the community.

In 2012, Dryden's operations resulted in an estimated equivalent dollar value of \$75.5 million in jobs created outside of the center, employing an estimated 1,565 individuals.

The combination of Dryden's annual expenditures and the estimated value of the jobs created outside of the center result in a total economic impact of \$328.4 million.

### Fiscal Year 2012: Indirect jobs created

Total personnel at the center:	1,151
Indirect jobs created *Using 1.36 multiplier	1,565
**Average annual pay for Local community:	\$48,237
Estimated annual dollar value of jobs created:	\$75.5M

$$(1,565 \times \$48,237 = \$75.5M)$$

### Fiscal Year 2012: Economic impact

■ Annual expenditures	\$252.9M
■ Estimated value of jobs created	\$75.5M
■ Grand Total	\$328.4M

\*Multipliers: LMI Economic Impact Database, Installations and Indirect/Induced Job Multipliers, February 1995

\*\*Avg. Annual Pay: Current tables for Average Annual Pay Levels in Metropolitan Areas and Average Annual Pay by State and Industry are accessible at: <http://www.bls.gov/cew/home.htm>

## Cover

*NASA's X-48C engages in a research flight in the skies over NASA Dryden Flight Research Center.*



NASA/James Mills

*Mike Moore and John Tucker perform a preflight checkout of the Stratospheric Observatory for Infrared Astronomy telescope cavity door seal system's electronics.*



ED12-0317-066

NASA/Tom Tschida

[www.nasa.gov](http://www.nasa.gov)

*Endeavour flew over a number of California landmarks, including the Hollywood sign, on top of a NASA 747 Shuttle Carrier Aircraft bound for Los Angeles International Airport.*