

National Aeronautics and  
Space Administration

FISCAL YEAR  
**2003**

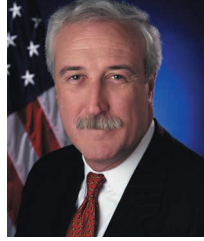
# Performance and Accountability Report



The interior of a crater surrounding the Mars Exploration Rover Opportunity at Meridiani Planum on Mars can be seen in this color image from the rover's panoramic camera. This is the darkest landing site ever visited by a spacecraft on Mars. The rim of the crater is approximately 10 meters (32 feet) from the rover. The crater is estimated to be 20 meters (65 feet) in diameter. Scientists are intrigued by the abundance of rock outcrops dispersed throughout the crater, as well as the crater's soil, which appears to be a mixture of coarse gray grains and fine reddish grains.

Data taken from the camera's near-infrared, green and blue filters were combined to create this approximate true color picture, taken on the first day of Opportunity's journey. The view is to the west-southwest of the rover.

Image Credit: NASA/JPL/Cornell



## Message from the Administrator

Fiscal Year 2003 was a challenging year for NASA. We forged ahead in science and technology. We made excellent progress in implementing the five government-wide initiatives of the President's Management Agenda, and we fully met or exceeded more than 80 percent of our annual performance goals. Sadly, however, 2003 will be remembered foremost as the year of the tragic Shuttle *Columbia* accident and the deaths of seven dedicated astronauts. No accomplishments can balance the scale of this horrific loss. We can, however, honor the legacy of our fallen heroes by correcting the problems that caused the accident, re-affirming our uncompromising commitment to safety, and implementing the recommendations of the *Columbia* Accident Investigation Board (CAIB) Report to make space flight as safe as humanly possible. We owe this to the astronauts' families and to the American people.

Perhaps NASA's greatest challenge in FY 2003 was continuing the work of the Agency as we mourned and rebounded from our loss. We made excellent progress in understanding the Earth system and the ability of humankind to adapt to its ever-changing conditions. We contributed to advances in aircraft and airspace safety and security through our Smart Icing System, which lets an aircraft "sense" when to initiate de-icing procedures, and through the Air Transportation Technologies Project to aid air traffic controllers. The first deployment of an airframe parachute on a certified aircraft made aviation history when the pilot and aircraft landed virtually unharmed. And, NASA developed disease surveillance tools that are helping world health organizations defend against a resurgence of vector-borne diseases.

In FY 2003, NASA found new answers to old questions by re-examining the mechanics of how liquid metals resist turning into solids, and we posed new challenges to old

answers by discovering the "new" oldest planet in our Milky Way Galaxy. We made progress in our expendable launch vehicle program and in our efforts to resolve problems related to long-duration space flight—efforts that have direct application to health-related issues on Earth. We also identified Education as a core NASA mission, established the Education Enterprise, and launched the Educator Astronaut Program.

Throughout FY 2003, NASA continued to redefine what is possible by leading the way in emerging scientific and technical fields. Many of the year's achievements came from the Hubble Space Telescope as it continued to bring the wonders of the universe down to Earth. Others came directly from experiments and studies done onboard *Columbia* before its tragic end. All of our achievements are a credit to the committed members of the NASA family who, even in the face of overwhelming loss, did not give up on NASA's Vision, Mission, and Goals.

As we look ahead to 2004 and beyond, we do so with reinvigorated spirit thanks to the Administration's new vision for the U.S. space exploration program. In tribute to all our fallen heroes, we accept the challenge to advance science and technology through new initiatives in human and robotic research and to continue our pursuit of answers to life's compelling questions.

Therefore, it is with pride, as well as sorrow, that I present the FY 2003 NASA Performance and Accountability Report.

A handwritten signature in black ink, appearing to read "Sean O'Keefe". The signature is stylized and fluid.

Sean O'Keefe  
Administrator  
January 2004



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# Guide to NASA's FY 2003 Performance and Accountability Report

This is the National Aeronautics and Space Administration's (NASA) *Fiscal Year 2003 (FY 2003) Performance and Accountability Report (PAR)*, which presents detailed information on NASA's performance and financial statements for FY 2003. It also reports on management challenges and NASA's plans and efforts to overcome them. This introduction is intended to familiarize the reader with the types of information contained in this report and where that information is located.

Clearly, NASA faces no greater management challenge in 2004 and beyond than overcoming the cultural and technical issues that contributed to the tragic loss of *Columbia* on February 1, 2003. Therefore, a special section on *Columbia* precedes the main body of the report. This section describes the events of that day and the investigations that followed, presents the details of the *Columbia* Accident Investigation Board (CAIB) Report and NASA's responses, and lays out NASA's return to flight plans.

The main body of the PAR is divided into three parts:

**Part 1—Management Discussion and Analysis.** This part presents background information on NASA's organization, FY 2003 performance achievements and financial highlights, management challenges and plans, and progress on implementing the President's Management Agenda.

**Part 2—Detailed Performance Data.** This part provides detailed information on NASA's progress toward achieving each of the Agency's annual performance goals (APGs). This includes detailed explanations and future plans for the APGs NASA did and did not achieve, as well as source references for more information.

**Part 3—Financial Information.** This part presents NASA's detailed FY 2003 financial statements, reports from NASA's external auditor, and follow up information on audit recommendations.

The appendices capture information on APG trends, NASA's performance and budget planning process, and audit follow up reports required by the *Inspector General Act*.

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**“This cause of exploration  
and discovery is not an option  
we choose. It is a desire  
written in the human heart....”**

*President George W. Bush,  
Columbia Memorial Service*

# Columbia

## Introduction

On the morning of January 16, 2003, the Space Shuttle *Columbia* and its crew of seven lifted off from the John F. Kennedy Space Center (KSC) on an Earth-orbiting mission devoted to space, life, and physical science research. As the families of the astronauts eloquently stated, the STS-107 crew members—Commander Rick Husband, Pilot Willie McCool, Mission Specialists Dave Brown, Kalpana Chawla and Laurel Clark, Payload Commander Michael Anderson, and Payload Specialist Ilan Ramon—headed into space with “a willingness to accept risk in the pursuit of knowledge—knowledge that might improve the quality of life for all mankind.”

Once in space, the STS-107 crew worked tirelessly on research aimed at fighting cancer, improving crop yields, developing fire-suppression techniques, constructing earthquake-resistant buildings, and understanding the effects of dust storms on the weather. In all, STS-107 carried more than 80 individual experiments, many of which relied upon the ingenuity of the astronauts assigned to them to record data, react to unexpected results, and quickly respond to the inevitable complications that are an integral part of laboratory science. “I think one of the legacies of NASA is that you

always push forward,” Commander Rick Husband said before the mission. “STS-107 is doing that on the science side—pushing human science knowledge forward.”

Sixteen days after their launch, the *Columbia* crewmembers and their vehicle were lost in a tragic re-entry accident in the skies over eastern Texas.

Throughout the world, people mourned the loss of the gallant astronauts and paid tribute to their courageous spirit. At a memorial service held at NASA’s Lyndon B. Johnson Space Center (JSC), President George W. Bush said, “This cause of exploration and discovery is not an option we choose. It is a desire written in the human heart where that part of creation seeks to understand all creation. We find the best among us, send them forth into unmapped darkness, and pray they will return. They go in peace for all mankind, and all mankind is in their debt.”

At the same memorial service, NASA Administrator Sean O’Keefe spoke of the Agency’s resolve to recover and move forward. “We have the tremendous duty to honor the legacy of these seven fallen heroes by finding out what caused the loss of *Columbia* and its crew, to correct what problems we find, and to make sure this never happens again,” he said.

"We owe this to you, the families, and to the American people. With an uncompromising commitment to safety, we will keep this solemn pledge." Administrator O'Keefe also vowed that NASA would return to the exploration objectives to which the astronauts dedicated their lives.

NASA's paramount objective is to return to Space Shuttle flight operations that are conducted as safely as humanly possible. Using the recommendations of the independent *Columbia* Accident Investigation Board as a baseline, the Agency's return to flight efforts will set the safety bar higher than ever, with everyone focused on helping NASA emerge from this enormous setback as a smarter, safer, and stronger agency.

## **Columbia Recovery Operations**

On the morning of February 1, 2003, when officials realized *Columbia* had missed its scheduled landing at KSC, NASA immediately mounted a rescue and recovery effort. As the magnitude of the situation became clearer, it was apparent that a rescue was not possible, but that a massive recovery effort would be needed.

NASA's actions in the initial minutes, hours, and days following the *Columbia* tragedy were guided by the NASA Contingency Action Plan for a major mishap. This plan was inspired by lessons learned from the *Challenger* accident in 1986, and is updated regularly based on crisis simulations. The plan, among other things, specifies notification and first response procedures and defines the roles and responsibilities of mishap response and investigation teams.

NASA activated its Contingency Action Plan for Space Flight Operations at 9:29 a.m., 13 minutes after *Columbia*'s scheduled landing. In a call from KSC to the White House Situation Room, Administrator O'Keefe notified the President and other senior White House staff of the loss of communications with *Columbia*. In addition, NASA notified members of Congress and the Government of Israel. Homeland Security Secretary Tom Ridge and the National Security Council also were made aware of the situation and followed events from the White House Situation Room.

The focus of the recovery operation quickly moved to the piney woods of eastern Texas and western Louisiana, where radar and visual sightings identified *Columbia*'s debris path. That afternoon, President Bush determined that emergency conditions in Texas and Louisiana, due to the presence on

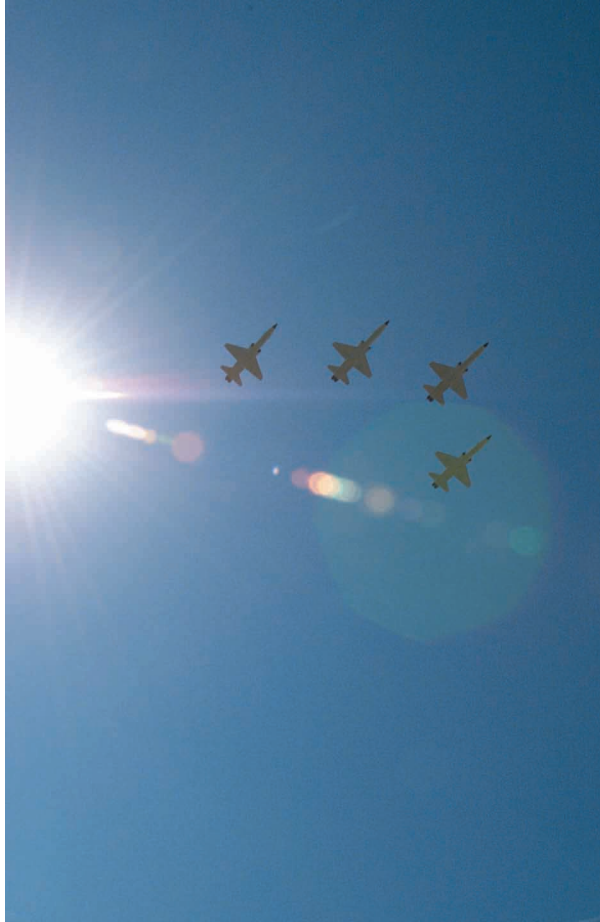


**The STS-107 crewmembers—Commander Rick Husband, Pilot Willie McCool, Mission Specialists Dave Brown, Kalpana Chawla and Laurel Clark, Payload Commander Michael Anderson, and Payload Specialist Ilan Ramon.**

the ground of *Columbia* debris containing toxic chemicals, were of sufficient severity and magnitude to warrant an emergency declaration under the *Robert T. Stafford Disaster Relief and Emergency Assistance Act*. Pursuant to that emergency declaration, the Federal Emergency Management Agency (FEMA) coordinated the efforts of other Federal agencies to recover Shuttle *Columbia* debris.

In a matter of hours, many Federal, state, and local authorities responded, including representatives from the Federal departments of Homeland Security, Defense, and Transportation; the Environmental Protection Agency; the Federal Bureau of Investigation; the U.S. and Texas Forest Services; the U.S. Park Service; the National Transportation Safety Board; and the Texas and Louisiana National Guards. In all, 14,000 responders representing 130 government and volunteer agencies, private groups, and contractors participated in the recovery work. In this unprecedented





**A Missing Man Formation honors the fallen heroes of *Columbia*.**

effort, the recovery team members, aided by private citizen volunteers, patiently searched an area nearly the size of Rhode Island under difficult weather and terrain conditions in an operation that involved air reconnaissance operations, lake diving, and a painstaking scouring of the countryside. Tragically, these difficult conditions claimed two more lives when Charles Krenek of the Texas Forest Service and pilot Tom Mier were killed in a helicopter crash while conducting a debris search over the Angelina National Forest in east Texas. They made the supreme sacrifice in helping NASA unravel the details behind the *Columbia* tragedy. Our sincerest condolences are extended to their families.

Despite significant hardships incurred during their work, the *Columbia* recovery team members and those who supported their work demonstrated inspiring resolve and dedication to the task at hand. T-shirts worn by many expressed their commitment by simply stating, "Their mission has become our mission."

The *Columbia* recovery team members helped locate, document, and collect 84,000 pieces of debris from *Columbia*. The recovered pieces ranged in size from as large as landing gear to as small as a coin. Thirty-eight percent of the Orbiter's dry weight (i.e., minus fuel) was recovered, including several critical parts from the left wing (the part of the Orbiter damaged by a foam strike during liftoff), and the Orbiter Experimental Recorder (the data recorder that verified and validated much of what was learned about the accident from NASA's Mission Control during *Columbia*'s re-entry). The recovered debris was first laid out for analysis in the Reusable Launch Vehicle Hangar at KSC and then moved to the Vehicle Assembly Building. The recovery operations center in Lufkin, Texas, closed on May 10, 2003, at the end of the formal recovery effort. (In the event that additional debris is found, a smaller recovery center remains at KSC.)

The costs for the Federal, state, and local authorities' recovery efforts were covered by the FEMA disaster relief fund. In addition, FEMA provided funds to cover expenses for the recovery activities from May 11, 2003, through January 2004. NASA incurred approximately \$23 million in recovery costs through the end of FY 2003 not covered by FEMA. NASA's costs included supporting the transportation of debris to the Reusable Launch Vehicle Hangar at KSC, *Columbia* Orbiter reconstruction, remote sensing and geospatial products to assist in locating debris, and infrastructure support at the debris storage site.

NASA wishes to recognize the Texas communities of Lufkin, Hemphill, Nacogdoches, Palestine, and Corsicana, as well as the Louisiana communities of Shreveport and Leesville, for the tremendous hospitality and support their citizens provided to the massive recovery effort. NASA will honor the kindness and sacrifices made by members of the Agency's extended family by using our Education Enterprise resources to help nurture the spirit of discovery and exploration in the young people growing up in these regions.

## **Retrieval of Data from *Columbia* Experiments**

The legacy of the STS-107 mission will be the results from scientific experiments conducted by the crew in the areas of fundamental biology, human physiology, materials research, and space manufacturing. NASA eventually recovered roughly 30 percent of the total data that was expected to be generated by these experiments, either through communication downlinks during the mission or,

incredibly, from experimental hardware that survived the disintegration of the Orbiter and the 200,000 foot fall.

From growing plants to cancer cells, the STS-107 mission conducted more than 80 experiments using the unique microgravity environment of space to advance NASA's vision of improving life on Earth. More than 70 international researchers are now reviewing the data from many of these experiments and will share STS-107's scientific contributions in the months and years ahead.

During the mission, the *Columbia* crew helped scientists study how prostate cancer cells and bone cells come together. The goal was to learn how these cells might interact in the early stages of metastasis, when cancer begins to spread. The crew succeeded in growing the largest cancer tissue structures ever cultured outside a living body.

Space flight research conducted on the STS-107 mission also helped change our understanding of how and why things burn—something scientists thought they understood well decades ago. One hydrogen experiment on *Columbia* produced the weakest flames ever created—100 times weaker than a birthday candle. This combustion research has already been used to investigate possible fuel efficiency improvements for jet engines and could make similar contributions in the automotive industry.

While gathering data on dust in Earth's atmosphere to better explain how these small particles affect climate, Israeli cameras in *Columbia*'s payload bay captured the first calibrated images from space of electrical phenomena in the atmosphere known as "sprites" and "elves." Scientists who only recently noted these phenomena now have real data to better understand how they occur. This same equipment also captured in real-time a smoke plume dissipating cloud cover in its vicinity, giving scientists new information about how smoke alters local climate.

In spite of its tragic ending, STS-107 advanced NASA's mission of inspiring the next generation of explorers. Students from nine states, as well as from Israel, Australia, China, Liechtenstein, Japan, Germany, and New Zealand, designed experiments that flew onboard *Columbia*. Throughout the mission the students monitored the progress of their experiments, often comparing the results with control groups on the ground. Although the STS-107 mission has ended, these students and others like them are just beginning their journey of exploration and discovery.

## **The *Columbia* Accident Investigation Board**

The NASA Contingency Action Plan specifies the selection of distinguished persons outside NASA to head an independent, seasoned accident investigation team. The process for chartering the investigation team, the *Columbia* Accident Investigation Board (CAIB), began about 10:30 a.m. on February 1, one hour after the Contingency Action Plan was initiated. Less than seven hours later, the CAIB was activated formally during the NASA Mishap Investigation Team teleconference at 5 p.m. The next day, NASA named retired Navy Admiral Harold W. Gehman Jr., a decorated Naval officer who investigated the October 2000 attack on the USS *Cole*, to chair the CAIB. Over the next several weeks, 12 additional members were chosen for their expertise in heading civil and military offices and for their knowledge of aviation accident investigations, aerospace safety, and NASA management and operations.

During its investigation and deliberations, the CAIB and its support staff reviewed more than 30,000 documents, conducted more than 200 interviews, heard testimony from dozens of expert witnesses, and reviewed more than 3,000 comments from the public. Throughout the seven-month period that the CAIB investigated the accident, NASA responded promptly to every request for documents, testimony, flight data, and hardware evidence. NASA made 400 Agency engineers available to assist with testing and detailed technical analysis of Space Shuttle components. Finally, NASA established an independent account to enable the CAIB to fund and track its expenses.

## **The *Columbia* Accident Investigation Board Final Report and NASA's Response**

On August 26, 2003, the CAIB released Volume I of its Final Report, which addresses the technical, procedural, and human failures that led to the *Columbia* accident. (The Final Report can be found online at <http://www.nasa.gov/columbia/home/index.html>.) Volume I detailed the immediate circumstances surrounding the accident, including the timeline of the mission from launch through the loss of the Orbiter and the physical causes behind the breakup of *Columbia* that began shortly after the vehicle re-entered the atmosphere.

According to CAIB Board Member Scott Hubbard, the proximate cause of the accident could be summed up in four words, “The foam did it.” 81.7 seconds after launch, NASA’s ground-based video cameras recorded one large and at least two small pieces of foam coming off the orange External Tank (ET) at the Bipod Ramp in the area where the ET and the Orbiter are joined. A split second later, rapid deceleration of the foam caused *Columbia*’s left wing to ram into it. Although video showed the resulting spray of foam as it disintegrated from the impact, the video cameras did not have a view of the exact location of the impact itself. NASA post-launch video analysis teams noticed the foam strike as they reviewed the video on the second day of the mission.

NASA learned after the *Columbia* accident that Air Force Space Command (AFSPC) tracking radars had detected a small object separating from the vicinity of the Shuttle. The CAIB concluded that this event was related to the foam impact event at launch. NASA has already begun the process of strengthening communications with AFSPC and other relevant Federal agencies in order to improve the flow of information to future NASA mission managers, and the AFSPC will become a key player in future mission safety enhancements.

Analysis by both NASA and Boeing (NASA’s contractor responsible for monitoring the Orbiter) during the flight indicated that the foam did not pose a safety-of-flight risk. However, the CAIB concluded that this analysis did not adequately model the effects of the foam striking the Shuttle’s reinforced carbon-carbon (RCC) at between 416 and 573 miles per hour. Therefore, the CAIB ordered a series of foam impact tests to be conducted at the Southwest Research Institute. One of these tests created a roughly 16 inch square hole in a RCC panel pulled from the Space Shuttle *Atlantis*, dramatically demonstrating the destructive potential of the lightweight ET foam traveling at these speeds.

Based on all available evidence, including debris and post-accident tests, the CAIB concluded that the foam impact created a hole up to ten inches square in the area of RCC panel eight on the Orbiter’s left wing. As *Columbia* began its deorbit maneuvers on Flight Day 17, neither the crew nor NASA ground controllers suspected that the Orbiter had a fatal hole in the critical Thermal Protection System (TPS) designed to protect the aluminum spaceframe of the vehicle from the tremendous heat of re-entry. This hole allowed hot plasma to enter the left wing during re-entry, weakening the underlying wing structure. During re-entry, despite attempts

by the automatic flight control systems to correct for the effects of the hole and the failing left wing, thermal and aerodynamic stresses eventually overcame the vehicle.

In addition to examining the immediate physical causes of the accident, the CAIB conducted a broad investigation of the Space Shuttle program. The Board looked at the program’s history, budget and funding profiles, and the organizational and cultural contributors to the accident. The Board’s deliberations on these issues were extensive, covering over 30 years of the Space Shuttle’s history and delving deeply into the budget and management of the program during the past two decades. The CAIB identified lapses in the Mission Management Team that ran the final *Columbia* mission, declines in Space Shuttle program funding, Space Shuttle launch schedule pressures related to International Space Station (ISS) construction, and a flawed NASA safety culture as contributing factors to the loss of *Columbia* and her crew.

The heart of the CAIB Final Report is the 29 recommendations and 25 observations made by the Board over the course of its inquiry. In accepting the Final Report from Admiral Gehman, NASA Administrator O’Keefe thanked the CAIB for its thorough and comprehensive review of the STS-107 mission and the entire Space Shuttle program. NASA accepts the findings of the CAIB, embraces the Final Report, and will comply with all of the Board’s recommendations. (The CAIB also released five additional volumes of supporting material.) The complete CAIB Report will serve as the blueprint for NASA’s return to flight plans.

## **Space Shuttle Return to Flight Plan**

During its seven-month investigation, the CAIB released a series of five preliminary recommendations. These preliminary recommendations addressed issues like ground inspection of RCC panels, improving communication with Federal agencies having unique technical capabilities, developing on-orbit inspection and repair techniques for TPS, and augmenting NASA’s still and video launch-recording capabilities. These preliminary recommendations gave NASA the opportunity to begin work on critical return to flight technical constraints.

Concurrently, NASA also conducted an internal review of the Space Shuttle program to identify technical and programmatic issues that would affect a safe return to flight. Within a week of the release of Volume I of the CAIB Final

Report, NASA issued its initial response to the recommendations in an *Implementation Plan for Return to Flight and Beyond*. The plan can be found at <http://www.returntoflight.org/>, and is being updated periodically, reflecting NASA's progress toward a safe return to flight and NASA's responses to future CAIB recommendations and other corrective actions. The first update of the Return to Flight Implementation Plan was issued on October 15, 2003.

**Return to Flight Process**—NASA's paramount objective is to ensure that all human and robotic space flight missions are conducted as safely as humanly possible. NASA will be guided by the CAIB recommendations. In addition, an independent task force of leading industry, academic, and government experts, chaired by veteran astronauts General Thomas Stafford and Richard Covey, will verify compliance. This task force will evaluate NASA's return to flight approach and recommend to the NASA Administrator additional guidance for the Agency's Return to Flight Implementation Plan.

NASA's Return to Flight Implementation Plan is milestone driven. The Space Shuttle workforce will focus on the key tasks that need to be accomplished in the weeks and months prior to the launch of the next Shuttle mission (STS-114). The exact date of the mission also will be milestone driven, not schedule driven. The launch date of STS-114 will depend entirely on NASA's progress in implementing the total Return to Flight Plan.

Some return to flight changes are already in place. For example, the next several flights of the Space Shuttle will occur during daylight hours, when conditions are better for observing the flight from launch through the ET separation. Future nighttime launches will be made possible through the certification of cameras mounted on the launch vehicle that are capable of returning useful engineering data to mission controllers. Finally, NASA is working with other Federal agencies to ensure that their assets will examine the Shuttle when it is orbiting Earth.

**First Flight Activities**—Fifteen of the CAIB recommendations are given as constraints that must be met before return to flight. Combined with NASA's own internally generated activities, they will result in significant technical, procedural, and organizational improvements to the safety of the Space Shuttle program. For example, the ET Bipod Ramp is being redesigned to reduce or eliminate the potential for debris generation, and the development and implementation of non-destructive evaluation tools and techniques will improve

our ability to inspect TPS components on the entire vehicle. Consistent with the CAIB's preliminary findings, NASA also will: optimize the use of photographic and video capabilities to identify potential anomalous activity during ascent and after ET separation; develop the ability to perform on-orbit visual inspection of an Orbiter's TPS using either remotely controlled devices or crew space walks; and develop the capability to perform TPS repairs on-orbit as necessary.

**Continuing to Fly Activities**—The return to flight process only begins with the first Shuttle flight after the *Columbia* accident. As individual Shuttle Orbiters undergo maintenance, NASA's Shuttle workforce will make additional improvements to each Orbiter. These changes include: hardening each Orbiter's TPS to reduce vulnerability to debris during both ascent and on-orbit operations; updating the Space Shuttle Modular Auxiliary Data System to improve data collection during flights; recertifying the Space Shuttle fleet as fit-to-fly if the program continues beyond 2010; and improving the inspection process that examines the dozens of miles of wiring that snake through each Orbiter.

**NASA Engineering and Safety Center**—On July 15, 2003, NASA Administrator Sean O'Keefe, addressing the critical issue of safety and mission assurance, announced plans to create the NASA Engineering and Safety Center (NESC) at the Agency's Langley Research Center in Virginia. The NESC will provide comprehensive examination of all NASA programs and projects and will become NASA's central location for independent engineering assessment, robust safety oversight, and trend analysis of all NASA programs by expert personnel. "Among the things we've learned during the investigation of the *Columbia* tragedy is the need to independently verify our engineering and safety standards," said O'Keefe. "The new NASA Engineering and Safety Center will have the capacity and authority to have direct operational influence on any Agency mission. When it comes to safety and engineering analysis, we need to improve our ability to share technical information, practices, and talent, and independently ensure we are in the best position to achieve mission success."

**Strengthening Safety and Mission Assurance Functions**—To better capitalize on the capabilities afforded by the NESC, both the Office of Safety and Mission Assurance (OSMA) and the Chief Engineer will realign or augment their safety and mission assurance and engineering functions. The changes will enable these Headquarters organizations to further extend the reach of their oversight



capabilities; provide flexibility to pursue independent analyses on problems identified; put additional emphasis on Agency safety, reliability, and quality problems as they arise; and allow OSMA to re-establish trend analysis leadership for the Agency.

NASA also will comply fully with all the CAIB recommendations calling for management and program changes to the Space Shuttle program. In particular, NASA will implement the CAIB recommendation to improve both the independence and competency of NASA Safety and Mission Assurance organizations and the training given to the Space Shuttle Mission Management Team. To support operational changes, additional Shuttle program workforce is necessary in competencies such as: systems and integration engineering; design and development engineering; quality and safety engineering and assurance; and mission analysis and planning. These critical recommendations go to the very heart of how NASA will further accept and account for risk and safety.

## Space Shuttle Payload Impacts

NASA currently is revising the Space Shuttle launch schedule in order to test out safety improvements and to provide continued re-supply and logistics support for the International Space Station (ISS). A new mission, STS-121, will be added to the manifest in order to provide additional margin for both Space Shuttle upgrade testing and re-supply to ISS. These manifest changes are necessary, but may delay assembly milestones beyond those directly caused by the loss of *Columbia*. Three major program areas have been affected by the changes in the Shuttle manifest: Space Station Assembly; On-orbit Research; and the Hubble Space Telescope (HST) servicing mission.

**Space Station Assembly**—NASA has maintained the original schedules for delivering all U.S.-provided ISS flight hardware to KSC, and is continuing with the integration and test of all ISS launch packages. However, delays to the ISS assembly sequence resulting from the *Columbia* accident will require NASA to retain critical contractor expertise longer than anticipated. The CAIB findings may further impact the ISS assembly manifest, resulting in added assembly and/or logistics missions. In addition, the ISS program must: re-certify or replace hardware with limited ground storage lives (e.g., solar arrays and batteries); re-manifest the logistics carrier scheduled for the first return mission to the ISS; increase U.S. operations in Russia; compensate for failed components remaining on-orbit until return to flight; address

equitable adjustments submitted by support contractors; and replace flight hardware lost on *Columbia*.

**On-Orbit Research**—The ISS researchers currently supported by NASA grants will be performing experiments on the ISS over the next three to five years. *Columbia* accident-related delays will affect the ISS research schedule over the entire five-year budget horizon and will require NASA to maintain ISS science teams longer than planned. In addition, NASA must maintain research hardware in a launch-ready state and retain contractor expertise to support on-orbit testing and checkout of this equipment.

Finally, NASA plans to replace selected research hardware lost on *Columbia* and extend grants for several of the scientists whose experiments were flown on *Columbia*. These grant extensions will allow some of these experiments to be flown on future missions to the ISS. (Data from other experiments were not immediately released to the researchers, because the experiments were deemed to be evidentiary material by the CAIB.) Extensions of other grants will allow researchers to analyze the physical data that was recovered.

**Hubble Space Telescope Servicing Mission**—Due to an estimated one-year slip of the final HST servicing mission, NASA must retain the expertise of a core contractor team of about 250 people supporting preparations for this delayed mission. In addition, the schedule slip, coupled with the recent loss of the second of six gyros on the telescope, necessitates the investigation of risk mitigation strategies to increase the probability of maintaining attitude control on the observatory during the delay. These efforts will include investigating a science mode for the HST employing only two gyros (nominally, at least three are required to conduct scientifically useful observations) and an option using the fine guidance sensor and fixed-head star tracker. While some of these options might have been considered for use after the originally scheduled servicing mission, their importance and urgency have increased significantly in the wake of the *Columbia* accident's schedule impacts.

Prior to the *Columbia* accident, the HST was slated for retrieval by Shuttle in 2010, and funding to support this mission was included in the President's FY 2004 budget request. However, NASA currently is examining alternate end-of-mission scenarios for the HST, including the use of an automated spacecraft launched by an expendable launch vehicle that would rendezvous and dock with the HST and de-orbit the observatory safely.

## Summary

On December 17, 2003, the world will commemorate the Centennial of Flight. We cannot look forward to the second century of flight without marveling at the first 100 years and the progress the age of aviation and space flight has made possible. However, progress is costly and our gains have not come easily. The technological breakthroughs that enable modern flight and exploration, and support the brave explorers who extend our horizons heavenward are the result of hard work, perseverance, and the commitment to overcome and learn from our setbacks and losses.

The loss of *Columbia* and its heroic crew was such a setback. Just as NASA rebounded from the tragic *Apollo 1* fire to successfully land six crews of astronaut explorers on the Moon, and from the *Challenger* accident to effectively use the Shuttles to place the HST into orbit, conduct science research missions, and build the ISS, NASA will learn lessons from the *Columbia* tragedy to make human space flight safer and more productive.

The *Columbia* accident reminds us that we cannot stop dreaming. We must continue to pursue our ambitious space research and exploration goals. We cannot disappoint future generations when we stand at the threshold of great advances that will benefit all of humanity. We will not let them down.



**PART  
1**

**Management  
Discussion  
and Analysis**





# Vision, Mission, and Organization

NASA's Vision and Mission statements reflect our hopes and challenges for the future. Through them, we emphasize our unique roles and focus our Agency on the things we do best. As the Nation's leading organization for research and development in aeronautics and space, we are explorers and pioneers who use our unique tools, capabilities, and perspectives for the benefit of our Nation and the world.

## **NASA'S VISION:**

To improve life here,  
To extend life to there,  
To find life beyond.

## **NASA'S MISSION:**

To understand and protect our home planet,  
To explore the universe and search for life,  
To inspire the next generation of explorers,  
... as only NASA can.

NASA's ten Agency Goals are derived from our Vision and Mission statements (see *Table 1*).

NASA addresses these ten long-term and implementing strategic Goals by achieving near-term strategic objectives, multi-year outcomes, and annual performance goals (APGs).

NASA's organization is composed of NASA Headquarters in Washington, DC, nine Field Centers nationwide, and the Jet Propulsion Laboratory, a Federally funded research and development center operated under contract by the California Institute of Technology. In addition, the private sector, academia, and a number of state and local governments partner with NASA via a wide variety of contractual tools in an even wider variety of program areas. NASA also conducts cooperative work with other U.S. agencies and international organizations. Together, our workforce of civil servants and allied partners and stakeholders is our greatest strength—a skilled, diverse group of scientists, engineers, managers, and support staff committed to achieving NASA's Vision and Mission safely, efficiently, and with integrity.

NASA's infrastructure consists of the Office of the Administrator, six Enterprises, the Office of Inspector General, and support

Mission	Goals
<b>Understand and protect our home planet</b>	Understand Earth's system and apply Earth system science to improve prediction of climate, weather, and natural hazards. Enable a safer, more secure, efficient, and environmentally-friendly air transport system. Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry and academia.
<b>Explore the universe and search for life</b>	Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space. Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.
<b>Inspire the next generation of explorers</b>	Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. Engage the public in shaping and sharing the experience of exploration and discovery.
<b>Space flight capabilities</b>	Ensure the provision of space access and improve it by increasing safety, reliability, and affordability. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery. Enable revolutionary capabilities through new technology.

**Table 1: NASA's Mission and Goals.**

offices that coordinate Agency-wide functions (see Figure 1). The Office of the Administrator oversees policy implementation, administration, and program management. The Enterprises set specific program direction and are responsible for NASA's main lines of business. These 18 business lines are called Themes (see Figure 2), and through them, NASA integrates budget with performance.

With the release of the FY 2004 budget, NASA created a new Education Enterprise, and renamed the Human Exploration and Development of Space (HEDS) Enterprise as the Space Flight Enterprise. In this report, accounting data will still reference HEDS, in accordance with the FY 2003 appropriations.

With the release of NASA's 2003 Strategic Plan, we vowed to operate as "One NASA" in pursuit of our Vision and Mission. We will operate as one team that applies our many unique capabilities to the pursuit of a shared Vision and clearly defined Mission. The One NASA philosophy enables the Agency to accomplish together what no one organizational element can possibly achieve on its own. The One NASA approach emphasizes a unified strategic plan, a

strong commitment to teamwork, tools, and capabilities for greater collaboration across the Agency, and more efficient systems within the Agency. The focus of One NASA is moving toward cultural change. NASA employees started the movement, and NASA leadership backs it.

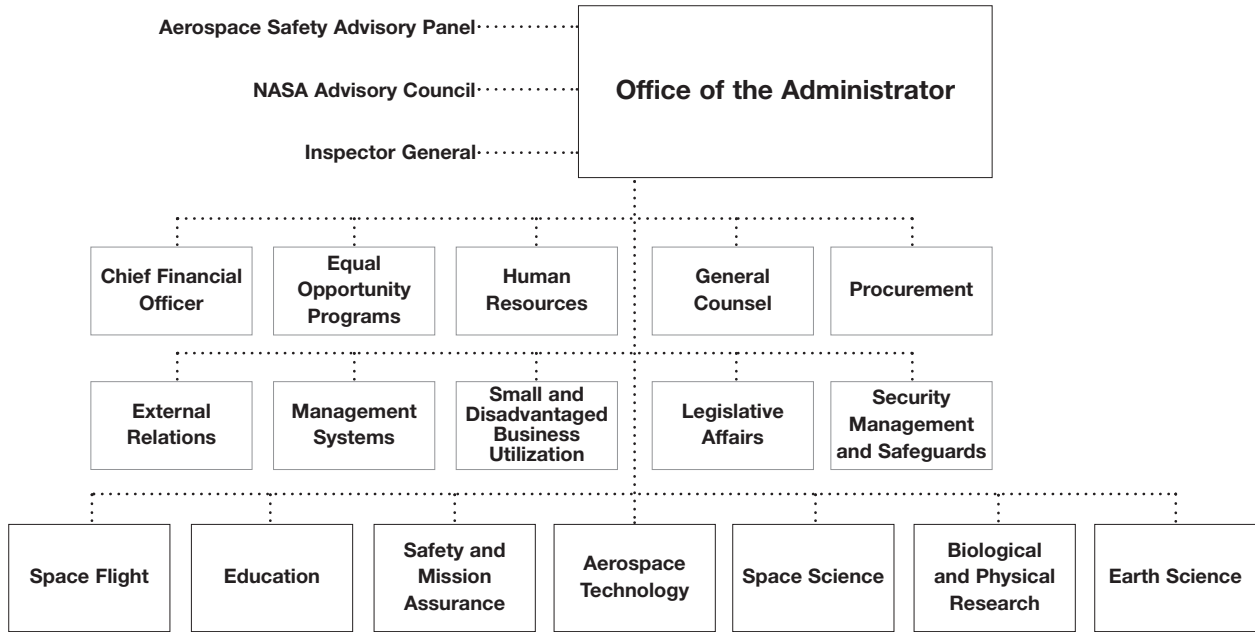


Figure 1: NASA's organizational infrastructure.

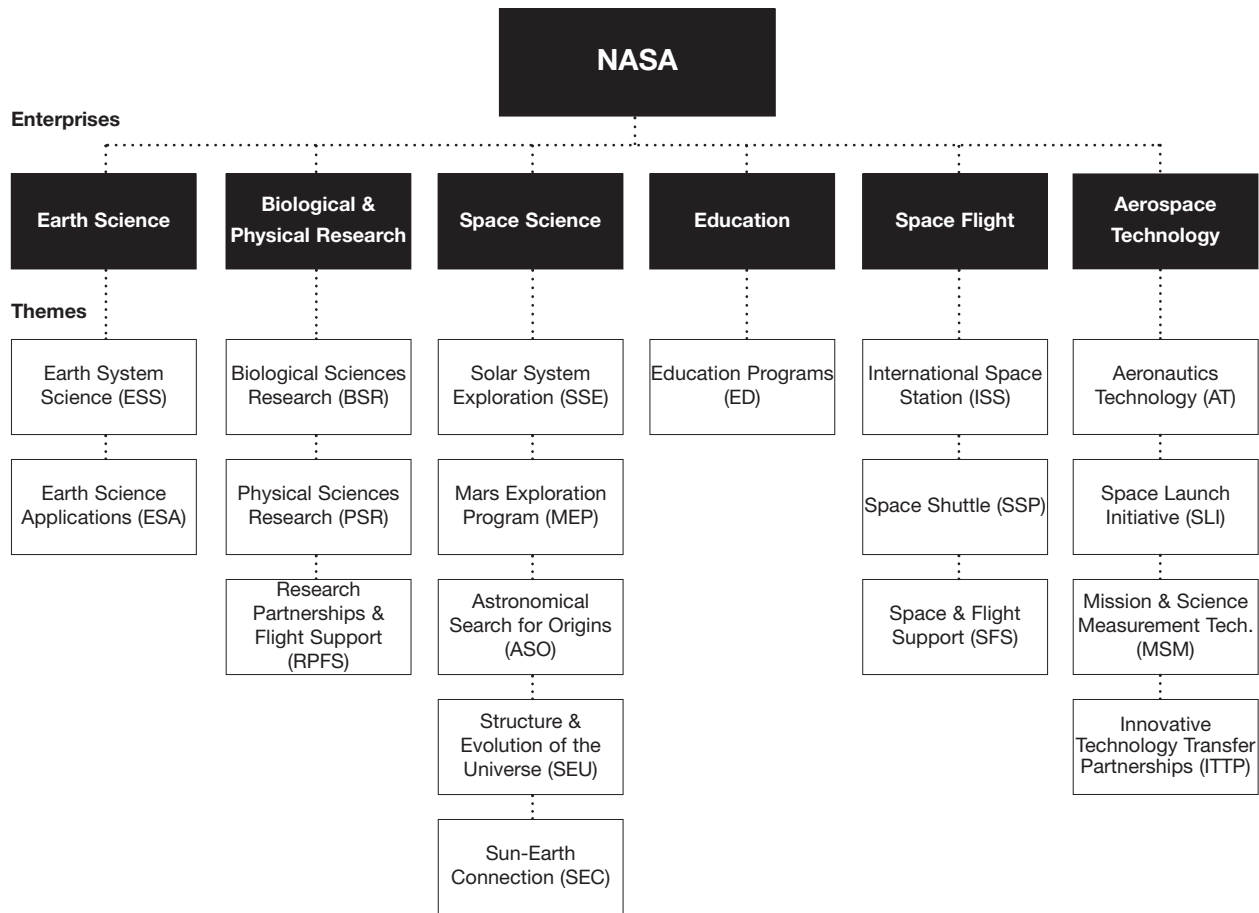


Figure 2: NASA's Enterprises and Themes as of September 30, 2003.

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# FY 2003 Performance Achievement Highlights

## **NASA's FY 2003 Performance Results**

In FY 2003, NASA achieved or exceeded 83 percent of its 116 annual performance goals (APGs).<sup>1</sup> Twelve percent of NASA's APGs saw significant progress, but were not fully achieved. The remaining five percent either were not achieved or were not pursued due to management decisions. (See *Figure 3 for the summary of NASA's APG ratings for FY 2003 and Figure 4 for the summary of NASA's APG ratings for FY 2003 for each strategic Goal and Implementing Strategies.*)

NASA's 116 APGs are derived from NASA's overarching Agency Goals, strategic objectives, and multi-year outcomes.

The Performance Achievement Highlights captured in the following pages are organized according to the ten Agency Goals. They are designed to provide the reader with the tangible benefits that NASA provides to its stakeholders by pursuing and achieving its goals.

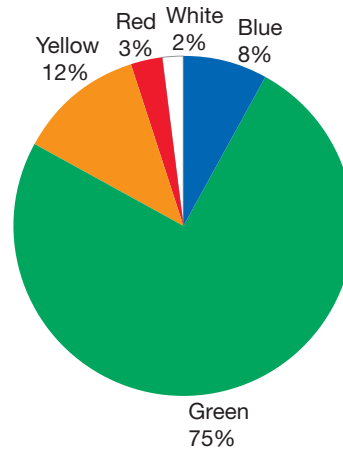
For the detailed performance data behind the Performance Achievement Highlights, please see Part 2 of this report. Part 2 is organized by the Agency's ten Goals and includes a summary for each APG presented in NASA's *FY 2003 Performance Plan*. Each APG summary includes the progress made and rating assigned to each APG, actions required to achieve the APG (if necessary), and sources to go to for more information. Also included are performance ratings for fundamental management support activities called Implementing Strategies. Trend information for NASA's APGs can be found in Appendix I.

<sup>1</sup> Performance information in this report is data available as of September 30, 2003.

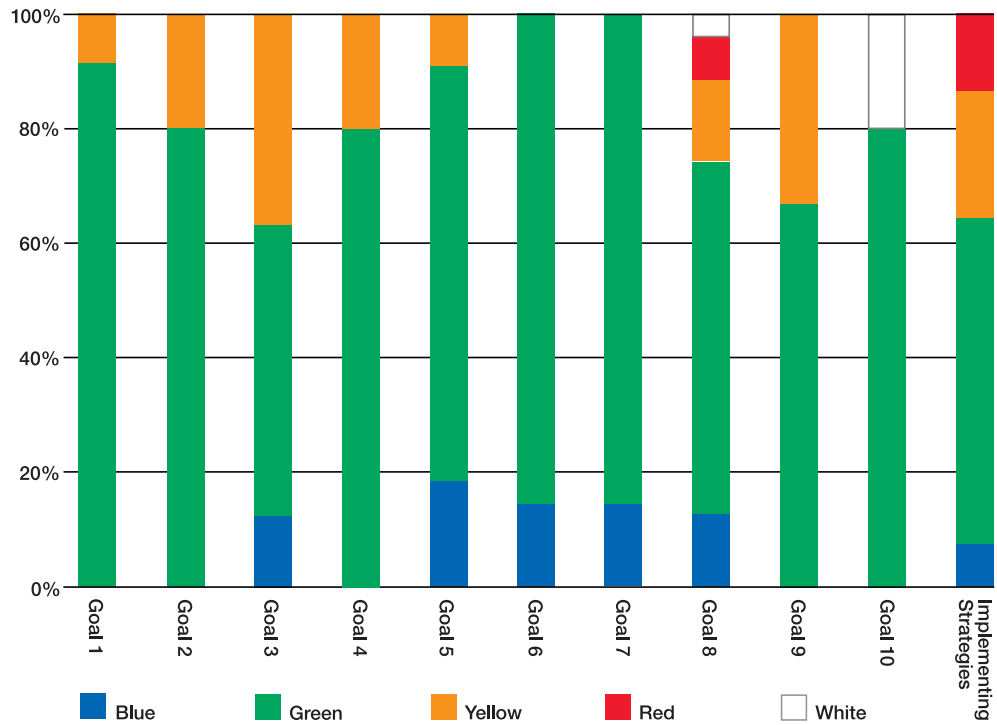


Performance results are indicated by color as follows:

- Blue:** Significantly exceeded annual performance goal;
- Green:** Achieved annual performance goal;
- Yellow:** Did not achieve annual performance goal, progress was significant and achievement is anticipated within next fiscal year;
- Red:** Failed to achieve annual performance goal, do not anticipate completion within the next fiscal year; and
- White:** Annual performance goal postponed or cancelled by management directive.



**Figure 3: NASA exceeded or met 83 percent of its APGs in FY 2003.**



**Figure 4: Summary of NASA's performance by Agency Goal.**

## **Goal 1:** Understand Earth's system and apply Earth system science to improve the prediction of climate, weather, and natural hazards.

*In FY 2003, NASA achieved 32 of 35 annual performance goals (APGs) under Goal 1. Significant strides in the other three APGs resulted in a "yellow" rating.*

Earth is a dynamic system of continents, oceans, atmosphere, ice, and life. The knowledge we gain about the Earth system dramatically improves our ability to predict climate, weather, and natural hazards. It also helps us assess and mitigate the effects of natural and human-induced disasters. Our view from space, coupled with our efforts here on Earth, afford us a unique perspective on how global change affects specific regions and how local changes fit in a global context.

In FY 2003, NASA continued its commitment to understanding the Earth system and made significant progress in this pursuit. This year's discoveries include the areas of Earth's gravity field, ozone recovery, and "space weather." Along with many other advances, these findings yielded a more complete picture of the Earth system and its ability to adapt to ever-changing conditions. Below are highlights of some of NASA's significant activities for this Goal.

### **OZONE HOLE RECOVERY**

Recent analyses of annual Antarctic ozone depletion over the past five years indicate a reduction in the rate of depletion. This may be an indication that worldwide efforts to reduce emissions of ozone-depleting chemicals are working, leading to progress in ozone recovery. NASA research originally proved that the widespread use of chlorofluorocarbons (used as refrigerants) and other chemicals, such as halons (used in fire extinguishers) and methyl bromide (used as a pesticide), contributed to increases in annual Antarctic ozone depletion. The link identified between these chemicals and ozone depletion led to an international plan to reduce their use and to increase the development and use of alternative chemicals that many nations are implementing. NASA continues to monitor global ozone concentrations.

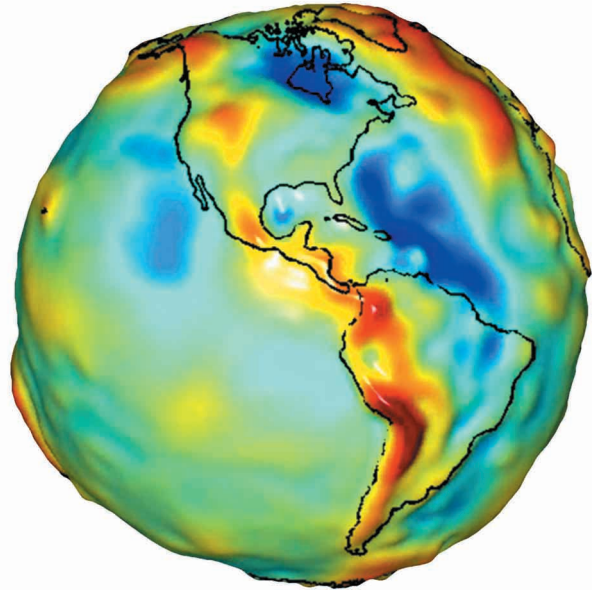
*Source: [http://www.nasa.gov/home/hqnews/2003/jul/HQ\\_03253\\_Ozone\\_Recovery.html](http://www.nasa.gov/home/hqnews/2003/jul/HQ_03253_Ozone_Recovery.html).*

Earth Science Enterprise

*For more information on this activity, see Goal 1, APG 3Y13, in Part 2 of this report.*

### **EARTH'S GRAVITY MAP IMPROVES 100-FOLD**

Scientists operating the joint U.S.–German Gravity Recovery and Climate Experiment (GRACE) satellite released the most accurate map to date of Earth's gravity field (see Figure 5). GRACE's goal is to help scientists understand the distribution of mass under Earth's surface, including changes in the volume of large aquifers (underground reservoirs). The preliminary data provided by GRACE has already improved



**Figure 5: A map of Earth's gravity field constructed from GRACE data. (Red indicates the strongest gravity field and blue indicates the weakest.)**

by ten to 100 times the accuracy of our knowledge about Earth's gravity field and its variations. GRACE data also was provided to eager oceanographers and geophysicists even before GRACE began routine science operations and is helping them unlock the secrets of ocean circulation and its effects on climate.

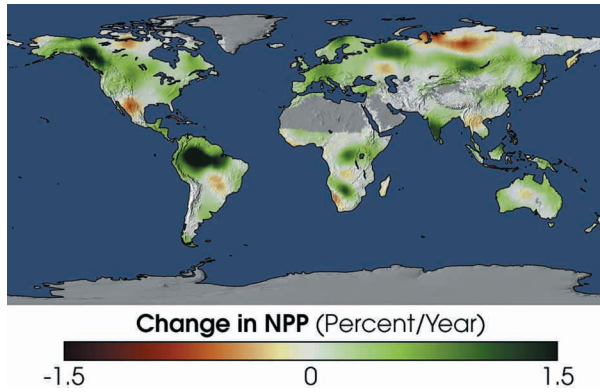
*Source: [http://www.nasa.gov/home/hqnews/2003/jul/HQ\\_03244\\_gravity\\_success.html](http://www.nasa.gov/home/hqnews/2003/jul/HQ_03244_gravity_success.html).*

Earth Science Enterprise

*For more information on this activity, see Goal 1, APGs 3Y6 and 3Y16, in Part 2 of this report.*

### **EARTH GETS GREENER**

The results of several NASA-sponsored studies published in scientific journals assert that some regions on Earth have increased their vegetation, or "greened," over the past 20 years. The most recent of these studies, appearing in the journal *Science*, states that climate changes have provided



**Figure 6: Map of increasing trends in Net Primary Productivity (NPP). (Green indicates increased NPP).**

extra water, heat, and sunlight in areas where one or more of those ingredients may have been lacking. NASA-sponsored researchers constructed a global map showing the spatial distribution of areas where net primary productivity (NPP) of plants is increasing or decreasing. Their analysis used satellite data of vegetation greenness and solar radiation absorption (see Figure 6). NPP is the difference between the carbon dioxide absorbed by plants during photosynthesis and the carbon dioxide lost by plants during respiration. NPP is the foundation of food, fiber, and fuel derived from plants, without which life on Earth could not exist.

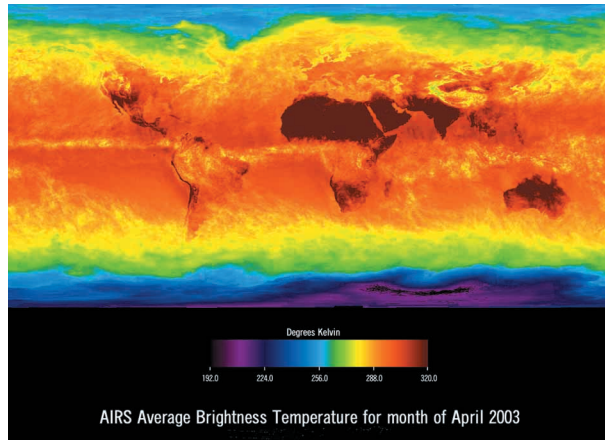
Sources: [http://www.nasa.gov/home/hqnews/2003/jun/HQ\\_03182\\_green\\_garden.html](http://www.nasa.gov/home/hqnews/2003/jun/HQ_03182_green_garden.html); and <http://www.sciencemag.org/cgi/content/full/300/5625/1560/DC1>.

Earth Science Enterprise

For more information on this activity, see Goal 1, APG 3Y3 in Part 2 of this report.

## USING AQUA DATA TO IMPROVE WEATHER PREDICTION

In FY 2003, instruments aboard the Aqua satellite continued to generate the most accurate, highest resolution measurements ever taken from space of the infrared brightness (radiance) of Earth's atmosphere. Data from the Atmospheric Infrared Sounder and the Advanced Microwave Sounding Unit aboard Aqua yielded a global, three-dimensional map of atmospheric temperature and humidity (see Figure 7).



**Figure 7: A map of average brightness temperature from Aqua satellite instruments.**

U.S., European, Australian, and Canadian research meteorologists are using the data to improve weather models and forecasting.

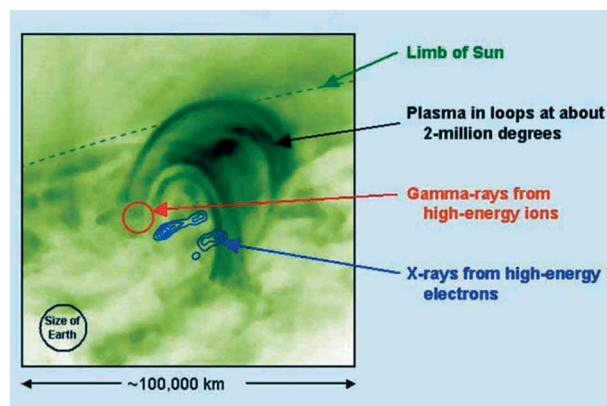
Source: [http://www.nasa.gov/home/hqnews/2003/apr/HQ\\_news\\_03151.html](http://www.nasa.gov/home/hqnews/2003/apr/HQ_news_03151.html).

Earth Science Enterprise

For more information on this activity, see Goal 1, APGs 3Y10 and 3Y19, in Part 2 of this report.

## A BETTER PICTURE OF SOLAR FLARES

Using the gamma-ray telescope onboard the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) satellite, scientists recently observed a major solar flare that produced a large amount of antimatter (see Figure 8). Antimatter annihilates normal matter in a burst of energy, inspiring science fiction writers to use it as a supremely powerful source to propel fictional starships. Current technology only creates minute quantities, usually in mile-long machines employed to smash atoms together. The newly



**Figure 8: The first gamma-ray image of a solar flare.**

observed flare created a half-kilo (about one pound) of antimatter—enough to power the entire United States for two days.

RHESSI's observations of this solar flare challenge current scientific theories. First, radiation was observed in a region of particle density 1,000 times lower than where antimatter should be created. Second, the gamma rays were detected 15,000 kilometers (approximately 9,300 miles) south of where X-rays were emitted from the solar atmosphere, rather than from the same location, as predicted by current theory. These results show that solar flares are capable of sorting particles causing ions and electrons to travel to different locations.

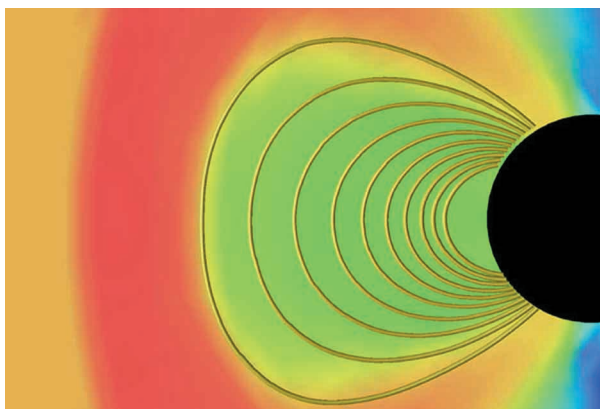
Source: <http://www.gsfc.nasa.gov/topstory/2003/0903rhessi.html>.

Space Science Enterprise

For more information on this activity, see Goal 1, APG 3S7, in Part 2 of this report.

## NEW INSIGHTS INTO SPACE WEATHER

“Killer” electrons penetrate orbiting spacecraft and wreak havoc by building up static electricity that can cause malfunctions in spacecraft operational systems. New observations from NASA's Polar and Wind satellites and National Oceanic and Atmospheric Administration's (NOAA's) Geostationary Operational Environmental Satellite (GOES) provided the Goddard Space Flight Center–Boston University research team with key data showing that the electrons may be energized by “surfing” magnetic waves driven by the solar wind.



**Figure 9: Earth's magnetosphere interacts with the solar wind to create high-energy “killer” electrons.**

The Wind satellite, orbiting outside the magnetosphere, identified density structures in the solar wind that disturb the magnetosphere at the proper frequency to pump particles to higher and higher energies, like pushing a child ever higher on a swing (see Figure 9). The Polar satellite, orbiting close to Earth, confirmed that the waves are not confined to just one part of the magnetosphere; rather, the waves are global. GOES measured the response of Earth's magnetosphere as it increased and decreased in size in time with the solar wind pulsations. These results show that the solar wind, and not some internal mechanism in the Earth's magnetosphere, is responsible for generating “killer” electrons. Understanding the origin of these particles will help satellite operators avoid their devastating effects.

Source: <http://www.gsfc.nasa.gov/topstory/2003/0904magwaves.html>.

Space Science Enterprise

Space Science Enterprise

NASA continues to provide the Nation with knowledge to improve our understanding of the nature and behavior of our home planet. Technologies developed to study subtle changes in Earth's atmosphere, oceans, and continents will be used to improve daily life here on Earth by improving the accuracy of daily weather monitoring and long-term climate change predictions.



**Goal 2:** Enable a safer, more secure, efficient, and environmentally friendly air transportation system.

In FY 2003, NASA achieved four of five annual performance goals (APGs) under Goal 2. Significant strides in one of the APGs resulted in a “yellow” rating.

Aviation is an indispensable part of our Nation’s transportation system, providing unequaled speed and mobility for people and goods. NASA develops breakthrough concepts and technologies for aircraft and airspace management to address safety and security issues and to create new opportunities for business, research, and innovation. Below are highlights of some of NASA’s significant activities for this Goal.

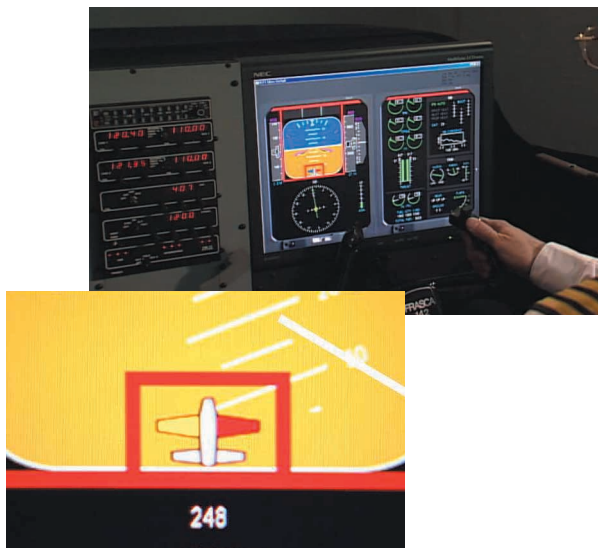


Figure 10: The Smart Icing System provides ice hazard notification to pilots.

**SMART ICING SYSTEM DEMONSTRATION**

To enable safer aircraft operations in icing conditions, NASA is developing a Smart Icing System (SIS) concept that, upon sensing the presence of ice on an aircraft, would automatically activate and manage the ice protection systems. The SIS provides the pilot with feedback on the icing event, including the effects on aircraft performance, stability, and control (see Figure 10). In FY 2003, the SIS concept was integrated into a desktop simulator and tested by pilots in training scenarios to identify appropriate awareness and action cues. NASA will

use the data gathered from the tests to design a more pilot-friendly interface for the SIS system. In the future, NASA plans to evaluate alternate parameter identification methods, integrate the SIS package into a flight-based system, and demonstrate the SIS in flight.

Source: <http://www.aero-space.nasa.gov>.

Aerospace Technology Enterprise

For more information on this activity, see Goal 2, APG 3R1, in Part 2 of this report.

**IMPROVING AIR TRAFFIC CONTROL**

Dynamic, reliable air traffic control is the hallmark of safe and efficient air travel. In congested airspace with interdependent traffic flows, a delay at one center often creates a domino effect that spreads quickly to multiple centers. During FY 2003, the Advanced Air Transportation Technologies Project developed and demonstrated an initial version of an active decision support tool for complex airspace. With this tool, the Multi-Center Traffic Management Advisor (McTMA), controllers will be able to manage arrival flows across multiple routes and arrival points more efficiently (see Figure 11). This technology, which can be extended across the National Airspace System, will increase efficiency and capacity in some of the most constrained airspace regions in the U.S. through regional collaboration. Some of McTMA’s highlight-

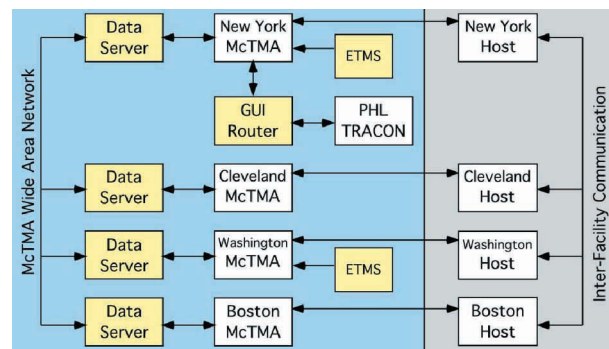
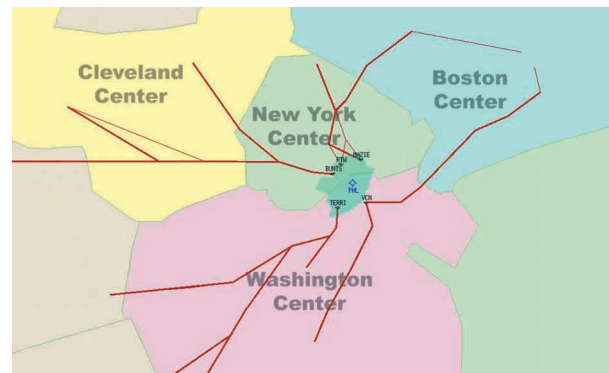


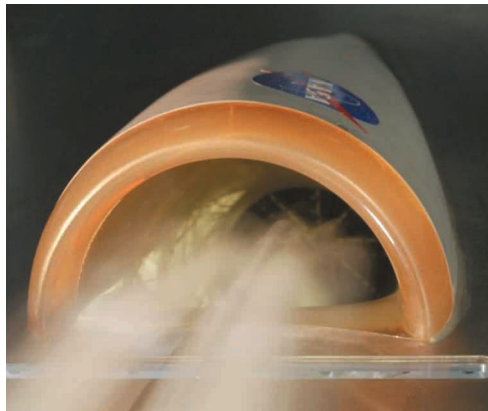
Figure 11: McTMA improves aircraft arrival management.

ed features include: arrival rush planning and control across multiple facilities; transition to time-based metering; scheduling information for airports and boundaries; and departure information for nearby airports.

Source: <http://asc.arc.nasa.gov/aatt/mctma.html>.

Aerospace Technology Enterprise

For more information on this activity, see Goal 2, APG 3R4, in Part 2 of this report.

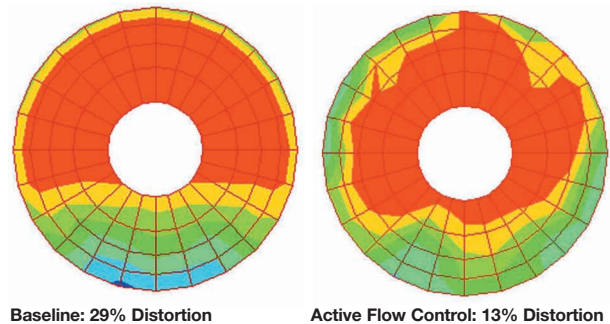


**Figure 12: Top-mounted active flow control inlets increase engine efficiency.**

## ACTIVE FLOW CONTROL FOR INLET DISTORTION

Aircraft inlets regulate airflow into aircraft engines. Efficient inlets improve aircraft speed and lift capabilities. Inlets are traditionally located under the wings of large aircraft, but as engine diameter increases, the weight of the engine, wing, and landing gear also increases. NASA is investigating the use of non-circular inlets mounted over the top of wings to increase speed and lift capabilities without increasing engine diameter for next generation subsonic aircraft.

In FY 2003, a model of an advanced top mounted inlet was studied in NASA's Basic Aerodynamics Research Tunnel (see Figure 12). The goal was to minimize the effects of flow distortion at the engine face using active airflow control. In normal inlets, a large boundary layer (an area where air



**Baseline: 29% Distortion**

**Active Flow Control: 13% Distortion**

**Figure 13: Active flow control reduces airflow distortion.**

meets the surface of the engine) is ingested into the inlet. This distorts the flow before it reaches the engine and reduces inlet efficiency. The baseline inlet produced a total flow distortion of 29 percent. With active flow control enabled on the experimental inlet, the distortion was reduced to 13 percent (see Figure 13).

Source: <http://www.aero-space.nasa.gov>.

Aerospace Technology Enterprise

### **Goal 3:** Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.

*In FY 2003, NASA achieved or exceeded five of eight annual performance goals (APGs) under Goal 3. Significant strides in the other three APGs resulted in a “yellow” rating.*

NASA helps create a more secure world by working with national, international, industrial, and academic partners, and by developing improvements in safety and security ranging from aircraft emergency systems to food supply integrity. NASA also works collaboratively with the Department of Defense (DoD) and other agencies to address specific national security concerns and to develop technologies and systems that help keep U.S. military aviation and space capabilities the most advanced in the world. Below are highlights of some of NASA’s significant activities for this Goal.

#### **AIRPLANE PARACHUTE TO SAVE LIVES**

Imagine a future where airplane crashes no longer result in fatalities and a total loss of the plane. NASA is taking steps to make that future a reality.

In October 2002, a pilot released his Cirrus SR-22 aircraft’s parachute and landed safely in a Texas mesquite tree grove. The pilot was uninjured and there was minimal damage to the plane. The safe landing made aviation history as the first emergency application of an airframe parachute on a



**Figure 14:** The airframe parachute saves lives.

certified aircraft. Ballistic Recovery Systems, Inc., developed the parachute through NASA’s Small Business Innovation Research program (see Figure 14).

*Sources: Aerospace Technology Innovation, vol 11, no 1, Spring 2003; and <http://nctn.hq.nasa.gov/innovation/innovation111/6-smallbiz3.html>.*

*Image: Ballistic Recovery Systems.  
Aerospace Technology Enterprise*

#### **FIGHTING CRIME WITH ADVANCED TECHNOLOGY**

In FY 2003, NASA continued working in the fight against crime through its partnership with the Federal Bureau of Investigation’s (FBI) Technical Support Working Group, whose members include DoD, the Central Intelligence Agency, the Secret Service, and the State Department. NASA delivered hyperspectral sensors in visible/near-infrared, ultraviolet, and shortwave infrared systems to the FBI Academy for use in forensics science research. The ultraviolet sensor is the world’s first desktop hyperspectral sensor.

*Source: <http://spd.nasa.gov>.*

*Biological and Physical Research Enterprise*

*For more information on this activity, see Goal 3, APG 3B9, in Part 2 of this report.*

#### **THERE’S SOMETHING IN THE AIR....**

This year, NASA’s Advanced Human Support Technology program funded research in a number of areas to create advanced sensors for detecting hazardous chemicals and microbes in the atmosphere. For example, the Trace Gas Analyzer, designed at NASA’s Jet Propulsion Laboratory (JPL) to check for ammonia leaks outside the International Space Station (ISS) and for hydrazine on astronaut space suits or within ISS airlocks, is being adapted to detect poly-chlorinated biphenyls at contaminated sites through a partnership between Con Edison and the JPL Innovative Technology Transfer Partnerships program. This device also can be tuned to detect agents of chemical terrorism.

*Source: [http://spaceresearch.nasa.gov/docs/highlights/NASA\\_Scientist\\_Develop\\_2001.pdf](http://spaceresearch.nasa.gov/docs/highlights/NASA_Scientist_Develop_2001.pdf).*

*Biological and Physical Research Enterprise*

#### **USING LIGHT SCATTERING TO TEST FLUID INTEGRITY**

NASA continues to make significant strides in dynamic light scattering, a method for the noninvasive measurement of miniscule particles ranging in size from three nanometers to

three microns. This year, a team of NASA and University of California researchers received a U.S. Patent for a Dynamic Light Scattering Homodyne Probe (U.S. Patent 6,469,787). Advances in light scattering technology like this probe hold promise for measuring contamination in fluid systems, enabling practical applications, such as testing potable water and evaluating engine oil integrity. Light scattering technology also has the potential to advance imaging of the human body.

Source: <http://patft.uspto.gov/netahtml/srchnum.htm> (search on patent number 6,469,787).

Biological and Physical Research Enterprise

## TRACKING DOWN DISEASE

The recent resurgence of vector-borne diseases (i.e., diseases transmitted by ticks, mosquitos, fleas, worms, mites, etc.), like malaria, yellow fever, Lyme disease, and hanta virus, highlight the relationship between human health and environmental change, both natural and human-induced. Temperature and humidity levels affect the population of certain vectors, which in turn, affects the probability of disease transmission. In FY 2003, NASA answered the call of world health organizations for the development and implementation of new disease surveillance tools through its Center for Health Applications of Aerospace Related Technologies, based at NASA Ames Research Center. The Center uses remote sensing as a tool for monitoring the environment and evaluating potential outbreaks of vector-borne diseases.

Source: <http://geo.arc.nasa.gov/sge/health/chaart.html>.

Biological and Physical Research Enterprise

## Goal 4: Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space.

*In FY 2003, NASA achieved four of five annual performance goals (APGs) under Goal 4.*

Knowledge from in-space research leads to new products, new medical treatments, and improved energy production with reduced pollution. We use the low gravity of space to better understand how matter changes from one form to another, how chemical reactions are completed, and how complex biological systems operate to form the basis for life. We also use space to enhance our understanding of high-temperature chemical reactions and combustion. Ultimately, we are learning how to produce advanced materials, new chemicals, and pharmaceuticals in space. Below are highlights of some of NASA's significant activities for this Goal.

## THE MAGIC OF MAGNETISM IN A FLUID

In FY 2003, NASA investigated the complex properties of magnetorheological (MR) fluids via its Investigating the Structure of Paramagnetic Aggregates from Colloidal Emulsions (InSPACE) experiment. MR fluids are liquids that harden near a magnet and become liquid again when the magnet is removed. Suspensions of paramagnetic particles in a nonmagnetic fluid are part of an exciting new class of controllable fluids. MR fluids have the potential to revolutionize electromechanical interfaces. Advances in MR fluid research and technology have inspired new applications for products, such as seat suspension systems and shock absorbers that take advantage of the properties of these fluids to provide superior vibration isolation (see Figure 15). InSPACE activities onboard the International Space Station (ISS) were completed in July 2003.

Source: <http://microgravity.grc.nasa.gov/inSPACE/>.

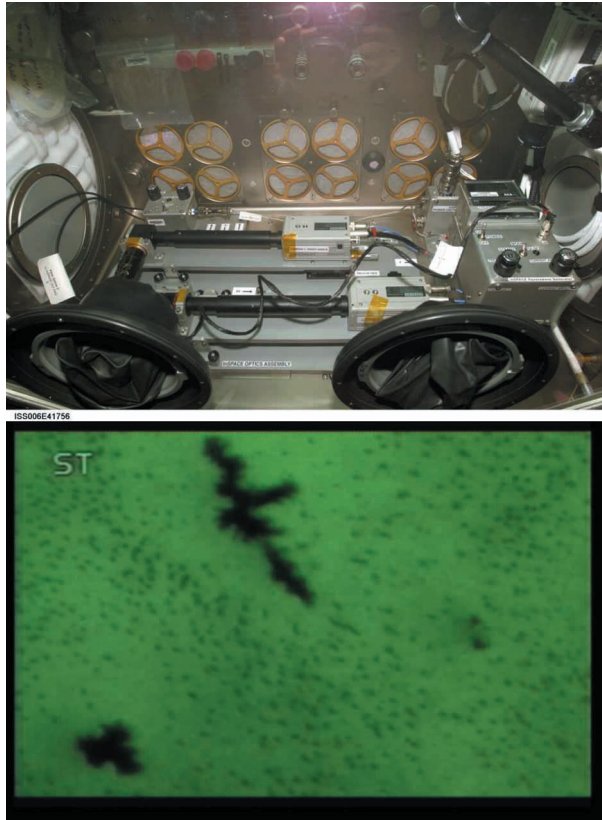
Biological and Physical Research Enterprise

*For more information on this activity, see Goal 4, APG 3B3, in Part 2 of this report.*

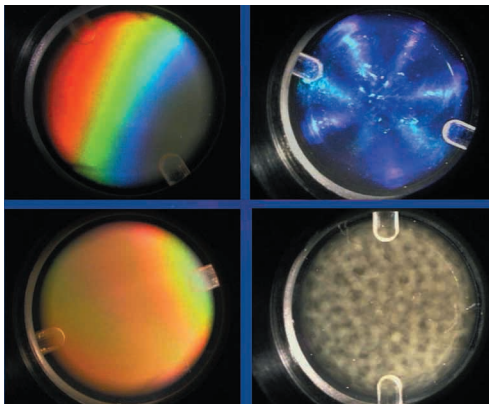
## UNDERSTANDING THE PHYSICS BEHIND LIQUID-TO-SOLID TRANSITIONS

An experiment flown on the ISS is helping researchers understand the basic nature of liquid-to-solid transitions (e.g., water freezing to become ice). Using different types of colloids (a gelatinous mixture between a liquid and a solid), the Physics of Colloids in Space (PCS) experiment





**Figure 15: The InSPACE experiment apparatus integrated in the Microgravity Science Glovebox aboard the ISS. The lower photo shows that the structures formed in space display more extended and diverse aggregate shapes than those formed on the ground, as observed during ISS Expedition 6.**



**Figure 16: Colloidal physics samples in experiment cells aboard the ISS.**

gathered data on the basic physical properties of colloids with the objective of understanding how colloidal structures grow, the rates at which they grow, and the structures that they form. The knowledge gained from PCS

should contribute to the development of novel materials that will lead to improvements in paints, ceramics, and both food and drug delivery products (see Figure 16).

Sources: <http://www.deas.harvard.edu/projects/weitzlab/research/nasaproj.html>; and <http://microgravity.grc.nasa.gov/6712/pcs.htm>.

Biological and Physical Research Enterprise

For more information on this activity, see Goal 4, APG 3B3, in Part 2 of this report.

## ANSWERING A 50-YEAR-OLD QUESTION

A physicist at Washington University in St. Louis led a research team that validated a 50-year-old hypothesis explaining the mechanics of how liquid metals resist turning into solids by forming irregular structures instead of forming regular crystals (necessary for solid formation). Using NASA's Electrostatic Levitator, which provides a means to study molten materials in a contamination-free, containerless environment, the research team challenged theories about crystal formation through a process called nucleation. Nucleation is the primary way that materials and biological systems change from one phase to another (i.e., solid to liquid, liquid to gas). Understanding the nucleation process will help researchers develop advanced materials and/or tailor the properties of materials for use in future rocket engines or spacecraft.

Source: <http://www.scipoc.msfc.nasa.gov/>.

Biological and Physical Research Enterprise

## EVALUATING THE SAFETY OF EXTENDED HUMAN SPACE FLIGHT

NASA continued to gain knowledge about the safety of human space flight by studying the effects of space flight on neural development. Researchers believe that the pre-birth development environment can affect brain structure and function at the cellular and sub-cellular levels. NASA's experiments revealed that a microgravity environment did not adversely affect brain development in test animals.

Source: <http://www.asma.org/Publication/abstract/v74n6/v74n6p615.html>.

Biological and Physical Research Enterprise

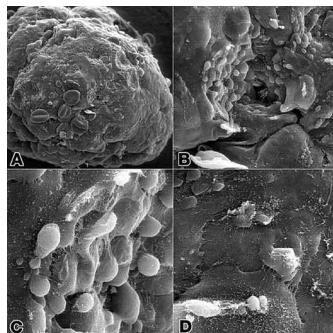
## ADVANCING RESEARCH IN CANCER AND OTHER DISEASES

Diseases like cancer are strongly tied to cell division and growth and the effect of environmental changes on both. Cell cultures that are synchronized so that all of the cells divide at

once are important in studying these diseases. NASA-funded investigators developed a new cell culture technology designed to minimize disturbances in the culture environment (see Figure 17). NASA demonstrated that the experimental cell lines could achieve the multiple, synchronized cell cycles that medical researchers need. This technology provides a better method to study the cell cycle in humans, mice, and bacteria.

Source: <http://www.sciencedirect.com/science/journal/00221910>.

Biological and Physical Research Enterprise



**Figure 17: Electron microscope images of breast cancer cells grown in the rotating wall bioreactor show the high degree of differentiation and structural development that can be attained using this technology.**

## **Goal 5: Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.**

*In FY 2003, NASA achieved or exceeded ten of 11 annual performance goals (APGs) under Goal 5. Significant strides in the other APG resulted in a “yellow” rating.*

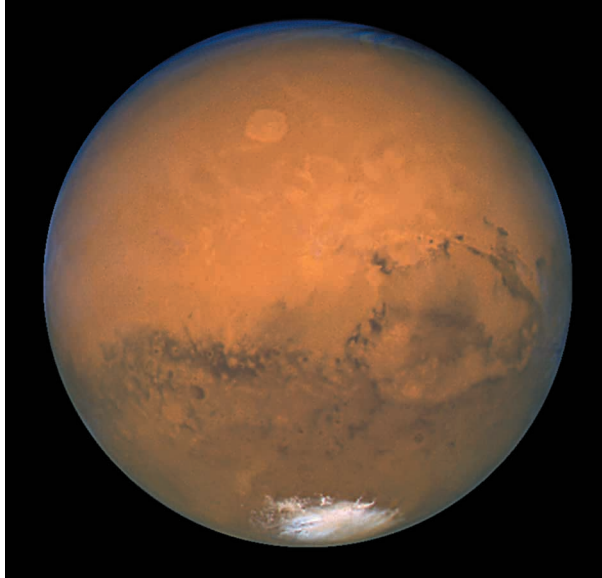
NASA’s observations of the solar system and the universe have enhanced the world’s knowledge about our origins, our destiny, and the potential for life in the cosmos. A series of recent technological breakthroughs and scientific discoveries have revolutionized our understanding of the formation and evolution of the universe and life. We have learned that life is robust and can survive in conditions on Earth previously thought unimaginable—where temperature, pressure, and mineral levels would seem toxic to life. By integrating observations of the universe, the solar system, extrasolar planets, and our Sun, NASA’s space science programs are providing a comprehensive new view of our origins and evolution. Below are highlights of some of NASA’s significant activities for this Goal.

### **HIGHLIGHTS FROM THE HUBBLE SPACE TELESCOPE**

In FY 2003, the Hubble Space Telescope (HST) continued to provide imagery that fueled the imaginations of millions of people worldwide. From imaging Mars at its closest pass to Earth in 60,000 years (see Figure 18) to discovering the oldest known planet in the Milky Way, HST brought the wonders of the universe closer to home and gave us valuable information about the existence, size, birth, and death of planets around other stars. Highlights from HST in 2003 include the following:

- Using data from HST, astronomers measured the largest object discovered in our solar system since the discovery of Pluto 72 years ago. Approximately half the size of Pluto, the icy world 2002 LM60, dubbed “Quaoar” (pronounced kwa-whar), is greater in volume than all the asteroids combined (see Figure 19). Like Pluto, Quaoar dwells in the Kuiper belt, an icy debris field of comet-like bodies extending seven billion miles beyond Neptune’s orbit. Quaoar is the farthest object in the solar system ever to be resolved by a telescope. It is about four billion miles (6.5 billion kilometers) from Earth, more than one billion miles farther than Pluto. Quaoar was discovered by the Near Earth Asteroid Tracking project. This finding advances our

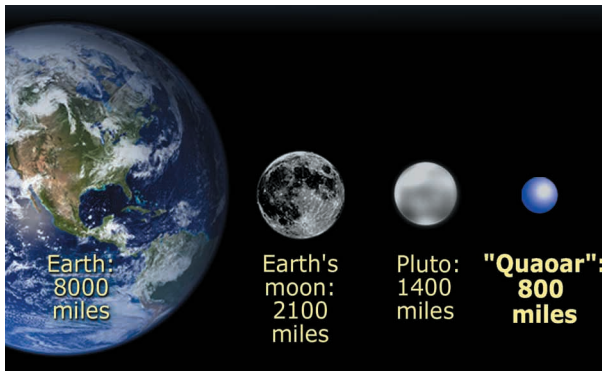




**Figure 18:** NASA's Hubble Space Telescope took this close-up of the red planet Mars when it was just 34,648,840 miles (55,760,220 kilometers) away. The picture was taken the day of its closest approach to Earth in 60,000 years.

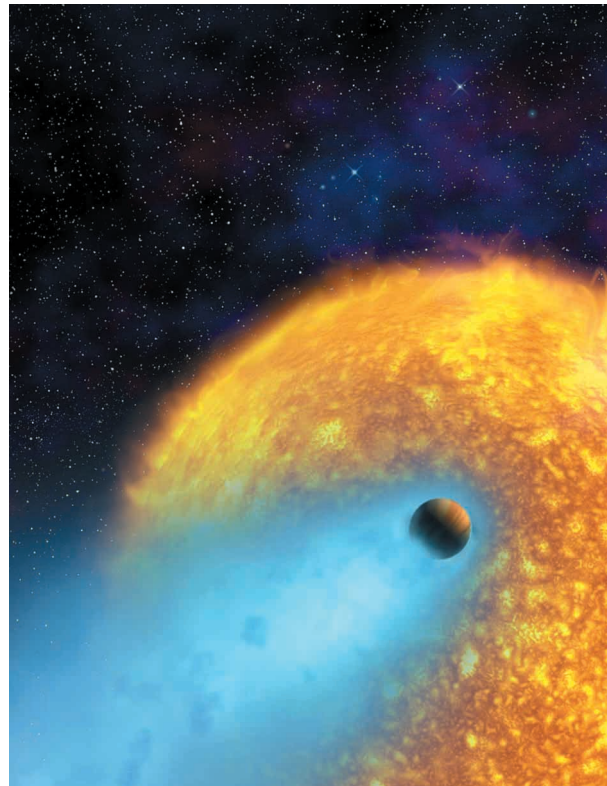
understanding of the origin and dynamics of the planets and the mysterious population of bodies dwelling in the far reaches of the solar system.

- Astronomers made the first astrometric measurement of the mass of a planet outside our solar system. The HST results place the planet G1 876b at 1.9 to 2.4 times the mass of Jupiter. G1 876b is only the second extrasolar planet for which such a precise mass has been determined. In the decade to come, NASA's Space Interferometry Mission will use astrometry to measure the mass of Earth-like extrasolar planets, giving us valuable information on the similarity of other planets to our own.



**Figure 19:** "Quaoar" compared by diameter with other solar system bodies.

- HST researchers discovered the oldest known planet in our Milky Way galaxy. At an estimated age of 13 billion years, the planet is more than twice as old as Earth. The ancient planet orbits two burned-out stars—a helium white-dwarf star and the millisecond pulsar B1620-26—in the crowded core of a cluster of more than 100,000 stars. Formed at a time when there were many fewer rocky solids available for building planets, this discovery suggests that the formation process must be very robust and that planet formation has been taking place for a very long time in our galaxy.



**Figure 20:** An artist's illustration of evaporating planet HD 209458b.

- The HST observed for the first time the atmosphere of an extrasolar planet evaporating off into space. Much of the planet may eventually disappear, leaving only a dense core. The scorched planet, called HD 209458b (see Figure 20), orbits only four million miles from its yellow, Sun-like star, HD 209458. The planet circles its parent star in a tight, 3.5-day orbit. The HST observations reveal a hot

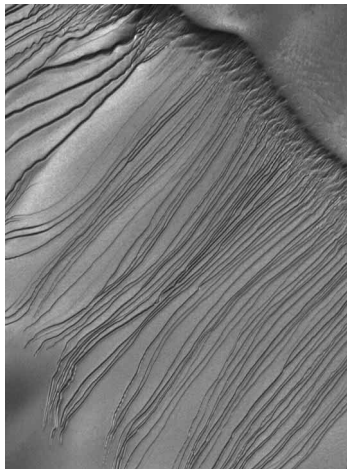
and expanded evaporating hydrogen atmosphere surrounding the planet. This huge envelope of hydrogen resembles a comet with a tail trailing behind the planet.

Sources: <http://www.hubblesite.org/newscenter/archive/2002/17/image>; <http://www.hubblesite.org/newscenter/archive/2002/27/image/a>; <http://www.hubblesite.org/newscenter/archive/2003/19/image/a>; and <http://www.hubblesite.org/newscenter/archive/2003/08/image/a>.

Space Science Enterprise

For more information on this activity, see Goal 5, APGs 3S4 and 3S5, in Part 2 of this report.

## LOOKING FOR LIFE IN THE NEIGHBORHOOD



**Figure 21: This image from the Mars Orbiter Camera (onboard the Mars Global Surveyor) shows the dune gullies of Russell Crater. Gullies start on the slope of this dune at the upper right and seem to indicate flow toward the lower left. The gullies might have been formed by the presence of a fluid that mixed with sand and avalanched down the dune slope.**

and some equatorial areas are dominated by ice, complementing the southern hemisphere discoveries of last year and challenging existing models of near-surface water stability.

Sources: [http://www.nasa.gov/home/hqnews/2003/feb/HP\\_news\\_03075.html](http://www.nasa.gov/home/hqnews/2003/feb/HP_news_03075.html); [http://www.nasa.gov/home/hqnews/2003/jun/HQ\\_03216\\_Frosty\\_Mars.html](http://www.nasa.gov/home/hqnews/2003/jun/HQ_03216_Frosty_Mars.html).

Space Science Enterprise

For more information on this activity, see Goal 5, APG 3S8, in Part 2 of this report.

Mars Global Surveyor's inventory of the planet's gully systems reveal landforms that evolved in the distant past, were buried, and then re-emerged (see Figure 21). These "fossil landscapes" indicate that overland flow of liquid water has been a significant process for more of Mars' history than previously thought, raising the possibility that habitable zones have existed on Mars throughout its history. In addition, Mars Odyssey results show that the upper meter of the northern plains

## LOOKING FOR LIFE IN ALL THE RIGHT PLACES

Recent discoveries about the ability of life to exist in extreme environments have revised conventional thinking about where to look for life in the solar system. Researchers discovered life in a hypersaline (extremely salty) environment in Lake Vida, Antarctica. The lake has a perennial ice cover 19 meters thick, the thickest ever recorded. The underlying brine is seven times saltier than seawater and hosts a varied microbial community including photosynthetic microorganisms. Environments similar to Lake Vida may exist on Mars or Europa (a moon of Jupiter suspected to have a sub-surface ocean). Studies of Lake Vida and other extreme environments extend our understanding of the limits to life on Earth and support our exploration of environments elsewhere in the solar system in the search for extraterrestrial life.

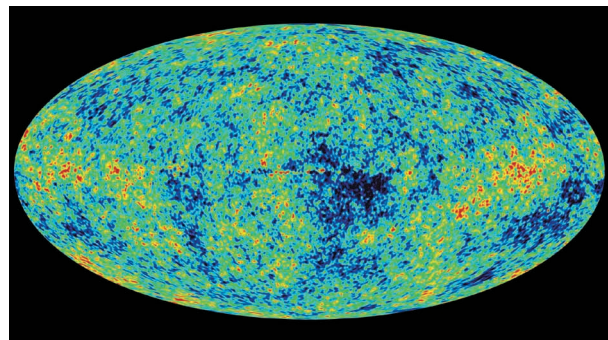
Source: <http://apod.gsfc.nasa.gov/apod/ap030128.html>.

Space Science Enterprise

For more information on this activity, see Goal 5, APG 3S6, in Part 2 of this report.

## A GLIMPSE OF THE FARTHEST REACHES OF THE UNIVERSE

On February 11, 2003, spectacular images of the infant universe were released from the first year of operation of NASA's Wilkinson Microwave Anisotropy Probe (WMAP) (see Figure 22). The WMAP results represent a milestone in how we view our universe by presenting the most detailed all-sky maps ever obtained of the cosmic microwave background, the afterglow of the "Big Bang" that created the universe. The new portrait precisely dates the universe at 13.7 billion years old and accurately defines its contents: four percent



**Figure 22: A "baby picture" of the universe from the WMAP. Colors indicate "warmer" (red) and "cooler" (blue) spots. The oval shape is a projection to display the whole sky, similar to the way the globe of Earth can be represented as an oval.**

ordinary matter, 23 percent of an unknown type of dark matter, and 73 percent dark energy.

Source: [http://www.nasa.gov/home/hqnews/2003/feb/HP\\_news\\_03064.html](http://www.nasa.gov/home/hqnews/2003/feb/HP_news_03064.html).

Space Science Enterprise

For more information on this activity, see Goal 5, APGs 3S1 and 3S3, in Part 2 of this report.

## CHASING DOWN “DARK MATTER”

NASA made considerable progress in pinning down how much of “dark matter” is made of atoms and how much is made of some other exotic particles. Combining data from NASA’s Far Ultraviolet Spectroscopic Explorer and Chandra X-ray Observatory satellites, astronomers found evidence for the existence of a large reservoir of normal matter consisting of familiar atoms in our local group of galaxies. This non-luminous matter in the form of a thin gas cloud surrounds and envelops the Milky Way and its neighbors. This is the first detection of the long-sought “missing matter.” The amount of matter discovered, about ten times as much matter as the entire Milky Way galaxy, is consistent with estimates based on gravity.

Source: <http://spaceflightnow.com/news/n0302/23fog/>.

Space Science Enterprise

For more information on this activity, see Goal 5, APG 3S1, in Part 2 of this report.

## Goal 6: Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

*In FY 2003, NASA achieved seven of seven annual performance goals (APGs) under Goal 6. One APG was exceeded significantly and received a “blue” rating.*

From the excitement of a launch countdown to the awe-inspiring images of the planets and galaxies, space exploration has a unique capacity to fire the imaginations of young and old alike. But the road to the planets does not begin at the launch pad; it begins at the classroom door.

In FY 2003, NASA strengthened its commitment to inspiring and motivating students. First, NASA established Education as a core mission of the Agency. Second, the Agency created a new Enterprise to facilitate coordination and integration of all NASA educational activities into a seamless pipeline for inspiring the next generation. And third, in collaboration with the new Education Enterprise, all NASA Enterprises and Centers touched and inspired our Nation’s students. Some highlights include the following:

- NASA used distance education and teleconferencing technology to reach over five million students via webcasting, point-to-point events, and multi-point education events.
- NASA reached over 70,000 practicing educators through workshop and exhibit participation in nine national educator conferences.
- NASA provided a ready source of information by distributing over 300,000 educational materials through educational conferences, responding to individual requests, and offering Space Link, an online educator resource featuring information and activities.

Below are specific highlights of some of NASA’s significant activities for this Goal.

## THE EDUCATOR ASTRONAUT PROGRAM

In FY 2003, NASA developed and launched the Educator Astronaut Program (EAP), which will train selected teachers to be Mission Specialists and will create revolutionary teaching tools that will allow the Educator Astronauts to share their experiences with students and other educators (see Figure 23). Teachers responded enthusiastically to the announcement of this program: NASA received 8,881





**Figure 23: Educator Astronaut Barbara Morgan works with an Earth crew team member.**

nominations and 1,685 applications. A Blue Ribbon Panel identified a list of "superior educators" to be reviewed by the Astronaut Office at Johnson Space Center (JSC) for final selection. Eventually, up to six educators will be selected for the Astronaut Corps. In FY 2004, the EAP will shift from recruitment to engagement as NASA and educators encourage students to become part of Earth Crew Teams. As of September 30, 2003, over 3,600 Earth Crew Teams have been formed with approximately 40,000 members.

Source: <http://edspace.nasa.gov>.

Education Enterprise

## NASA EXPLORER SCHOOLS PROGRAM

This year, NASA developed and launched the NASA Explorer Schools Program, a unique, three-year partnership between



**Figure 24: A student gets hands-on science experience in the Explorer schools' classroom.**

NASA and 50 school educator/administrator teams around the country. The program targets underserved populations in grades 5–8 and provides the Explorer Schools linkages with NASA Centers, on-going educator professional development, and student and family opportunities (see Figure 24).

Source: [http://explorerschools.](http://explorerschools.nasa.gov)

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

Education Enterprise, Biological and Physical Research Enterprise

For more information on this activity, see Goal 6, APG 3B11, in Part 2 of this report.

## VIRTUAL INSPIRATION FOR EDUCATORS AND STUDENTS

NASAexplores ([www.nasaexplores.com](http://www.nasaexplores.com)) provides educators and students with free, weekly online articles and lesson activities based on human space flight and aerospace technology content. These materials, written at three grade levels (K–4, 5–8, and 9–12), support national education standards. During FY 2003, the NASAexplores Web site logged over 500,000 unique computer addresses and 20.2 million "hits." The NASAexplores team conducted workshops for 188 educators and exhibited at conventions with an estimated 19,150 attendees.

Source: Office of Space Flight at NASA Headquarters, <http://www.spaceflight.nasa.gov>; <http://nasaexplores.com>; <http://education.jsc.nasa.gov/Educators/DLE.htm>; and <http://education.jpl.nasa.gov/resources/index.html>.

Space Flight Enterprise, Education Enterprise

For more information on this activity, see Goal 6, APG 3H23, in Part 2 of this report.

## HANDS-ON TRAINING AND INSPIRATION

NASA's Space Flight and Life Sciences Training Program (SLSTP) is an investment in tomorrow. It is an intensive six-week summer program at Kennedy Space Center (KSC) for undergraduate college students interested in learning how to design and conduct biological research and operations in space and to assess the environmental impacts of a launch site. The program emphasizes the unique features of experiments conducted in the space flight environment and the challenges associated with planning and conducting long-duration space flight missions and experiments. Thirty students participated in 2003, including a number of students from underrepresented groups. This year's class also chartered an alumni group to facilitate continued mentoring among students who have participated in the program.

Source: <http://www.spaceflight.nasa.gov>; <http://nasaexplores.com>; <http://education.jsc.nasa.gov/Educators/DLE.htm>; and <http://education.jpl.nasa.gov/resources/index.html>.

Space Flight Enterprise, Education Enterprise

For more information on this activity, see Goal 6, APG 3H23, in Part 2 of this report.

## AWARD-WINNING TELEVISION PROGRAMS FOR OUR CHILDREN

The NASA CONNECT™ program, "Measurement, Ratios, and Graphing: Who Added the 'Micro' to Gravity," won a 2003 Regional Emmy Award in the Children/Youth Category.

Distributed through public and cable broadcasting media, this program, targeting grades 6–8, reached 260,710 subscribing educators representing 8,600,000 students.

Source: <http://connect.larc.nasa.gov>.

Education Enterprise, Biological and Physical Research Enterprise  
For more information on this activity, see Goal 6, APG 3B11, in Part 2 of this report.

## EDUCATION AROUND THE GLOBE

The 2003 GLOBE Learning Expedition (June 30–July 4), with the theme “Local Discoveries, Global Understandings,” took place in Šibenik, Croatia. The Expedition, partially funded by NASA, featured 54 teams from 23 countries, and consisted of approximately 400 students and teachers. Teams were competitively selected to showcase their use of Earth science data. (Fourteen of the 54 teams were from the United States.) The GLOBE program, supported by state-level science curricula, engages students, teachers, and scientists worldwide in Earth system research and education.

Source: [http://www.nasa.gov/home/hqnews/2003/jun/HQ\\_03211\\_globe.html](http://www.nasa.gov/home/hqnews/2003/jun/HQ_03211_globe.html).

Earth Science Enterprise

## CLOUDS IN S'COOL?

The Students' Cloud Observations On-Line (S'COOL) Project collected nearly 9,000 student ground observations of clouds in the past year. NASA's CERES (Clouds and the Earth's Radiant Energy System) Science Team will use these observations as one element in the validation of its climate data records by comparing the surface- and space-based observations to learn more about clouds and climate. The data also are available for use in student research projects through an online interface. Nearly 300 new teachers registered to participate in S'COOL this year.

Source: <http://asd-www.larc.nasa.gov/SCOOL/>.

Earth Science Enterprise

## INSPIRING STUDENTS AROUND THE WORLD

This year, the second World Space Congress, held in Houston, Texas, in October 2002, included educational and student outreach activities. Over 10,000 students, educators, and young professionals from more than 30 countries participated in 14 events staffed by over 400 volunteers (see Figure 25). The event achieved its ambitious goal of engaging students from every educational level (kindergarten



Figure 25: Students at the World Space Congress.

through graduate school), along with teachers, parents, and aerospace professionals. NASA provided the leadership for this venture, as well as technical expertise and other resources.

Source: [http://www.aiaa.org/wsc2002/special\\_educ\\_report.cfm](http://www.aiaa.org/wsc2002/special_educ_report.cfm).

Biological and Physical Research Enterprise

**Goal 7:** Engage the public in shaping and sharing the experience of exploration and discovery.

*In FY 2003, NASA achieved seven of seven annual performance goals (APGs) under Goal 7.*

NASA's challenging and exciting missions engage and educate the public. By stimulating people's imaginations and creativity, and by communicating the significance of our discoveries and developments to the world, we help improve the scientific and technological literacy of our Nation. Below are highlights of some of NASA's significant activities for this Goal.

**CELEBRATING A CENTENNIAL OF FLIGHT**

This year, NASA capitalized on the opportunity presented by the Centennial of Flight celebration to partner with industry, academia, and other government agencies to engage the public in the excitement of exploration and discovery. Although the celebration will end in December 2003, NASA hopes that the spirit inspired by this celebration will continue well into the 21st century. Highlights from this year's celebration include the following:

- NASA worked with the Art Institute of Chicago to present a history of aeronautically engineered forms and artifacts from NASA's collection dating from the 1930s. The exhibit also includes designs for future airplanes, including those with morphing wings and biologically inspired forms, aimed at making commercial air travel accident free, environmentally friendly, affordable, and accessible (see Figure 26). The exhibit will be on display through February 8, 2004.



**Figure 26:** NASA's Aerospace Design display at the Art Institute of Chicago is engaging new audiences in exploration and discovery.

- NASA developed "Our Earth to Orbit: Engineering Design Challenge" to help students learn how the Wright brothers developed propellers for their aircraft.
- NASA launched the "Wright Way" Web site, which contains a wealth of background information on the Wrights, as well as classroom learning activities related to their research.
- To commemorate advances in flight, NASA sponsored the Rockefeller Center Plaza "Centennial of Flight" exhibit (see Figure 27). The exhibit included: mockups of experimental NASA planes; participation by NASA astronauts; Shuttle Launch Theatre; and a space suit photo opportunity for visitors. The exhibit averaged 150,000 to 175,000 visitors per day.



**Figure 27:** NASA's Centennial of Flight exhibit at Rockefeller Center where rich heritage of powered flight was on display.

- In FY 2003 NASA produced two programs with a Centennial of Flight focus: "The Case of the Challenging Flight" and "The Case of the 'Wright' Invention."

Sources: [http://www.aero-space.nasa.gov/curevent/news/vol4\\_iss3/aerospace.htm](http://www.aero-space.nasa.gov/curevent/news/vol4_iss3/aerospace.htm); <http://wright.nasa.gov>; <http://eto.nasa.gov>; and <http://scifiles.larc.nasa.gov>.

Aerospace Technology Enterprise

**BRINGING THE EXCITEMENT OF SPACE TO YOUR HOMETOWN**

In FY 2003, NASA and our partners brought the excitement of space closer to home. Highlights of this year's activities include the following:

- NASA redesigned and launched a new Web portal to improve the usability of the site for the Agency's diverse audiences and primary stakeholders. The redesigned portal (<http://www.nasa.gov>) is more accessible, community-focused, offers a single place where all of the public can access the best of NASA's Web offerings, and through the "MyNASA" sub-site, customize the content they want to



see. The improved portal has proven popular with NASA's audiences, receiving over 1.4 billion hits between February and June 2003. On February 1, 2003, [www.nasa.gov](http://www.nasa.gov) withstood a 50-fold increase in traffic in the 20 minutes following the Shuttle *Columbia* accident, recording nearly 75 million hits with 100 percent availability even during periods of extremely high demand.

Education Enterprise, NASA Office of Public Affairs

- NASA partnered with the American Library Association and Apple Computer to launch a two-year national tour to inform the general public about space research. The exhibit explains how NASA research and technology has contributed to every aspect of American life, as well as how the Shuttle and International Space Station (ISS), people, inanimate objects, and American industry work in the microgravity of space. Over 400 libraries competed for 120 opportunities to take part in the national tour. Launched in July 2003, the exhibit will tour five locations per month. Estimated traffic through the five libraries in the opening month was 250,000 people. NASA grants added an average of 20 new and/or additional books on space to each library's permanent collection.

Biological and Physical Research Enterprise

- NASA worked with partners in local communities via the NASA Days program to develop and deliver to the public an informative and entertaining program about the ISS and to share the excitement of space with people in mid-size cities in central and eastern states.

Space Flight Enterprise

- Using the ISS Trailer Exhibit, NASA provided a unique experience for the general public, especially students.



**Figure 28: A NASA Astronaut inspires the next generation of explorers in the ISS Trailer Exhibit.**

This mobile exhibit consists of two 48-foot trailers linked in an L-shape. Visitors enter one end and move through the exhibit in groups of approximately 15 to 20 people (see Figure 28). Through a series of interactive displays, visitors are able to visualize what it would be like to live and work in space. The exhibit traveled to 21 cities and hosted nearly 92,000 visitors.

Sources: <http://members.ala.org/nasa/introduction.html>;

<http://www.spaceflight.nasa.gov>;

<http://spaceflight.nasa.gov/station/index.html>; and

<http://spaceflight.nasa.gov/realdata/tracking/index.html>.

Space Flight Enterprise

For more information on this activity, see Goal 7, APGs 3B12, 3H21, and 3H22 and Implementing Strategy 2, APG 3MS6, in Part 2 of this report.

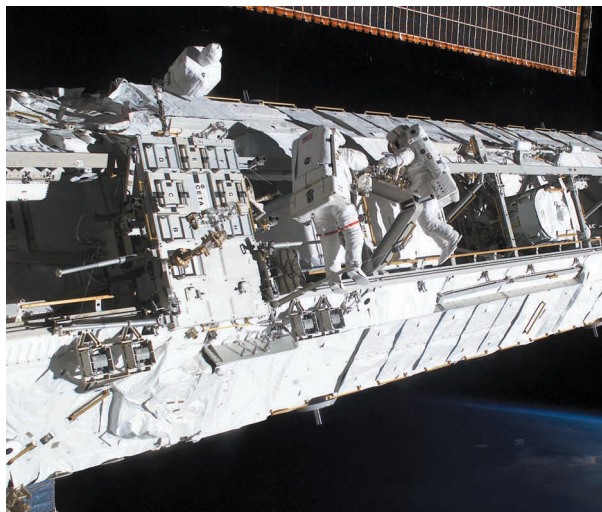
**Goal 8:** Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.

In FY 2003, NASA achieved or exceeded 19 of 25 annual performance goals (APGs) under Goal 8. Three APGs saw significant progress and received a “yellow” rating. In the other three APGs, the goal was either not met, and thus assigned a “red” rating, or postponed by management directive and assigned a “white” rating.

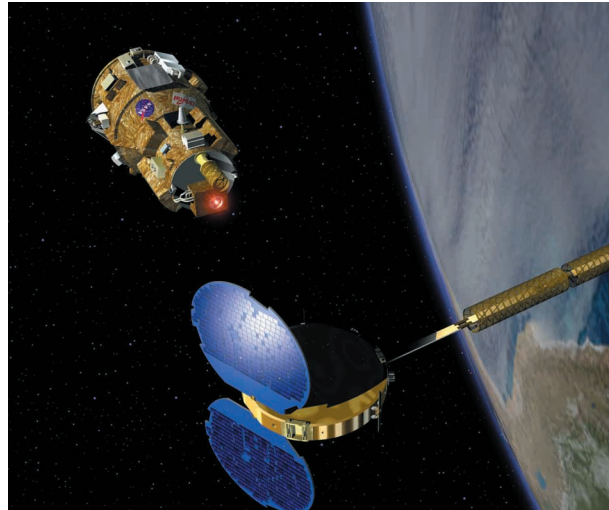
One of NASA’s primary roles is improving the Nation’s access to space through the application of new technology. Currently, access to space is provided by the Space Shuttle and a fleet of expendable launch vehicles (ELVs) developed and built by U.S. industry. NASA also provides access to the International Space Station (ISS) as a research platform for advancing our knowledge of science. NASA is improving our current access to space and expanding the Nation’s space capabilities for the future. Below are highlights of some of NASA’s significant activities for this Goal.

**SPACE SHUTTLE AND INTERNATIONAL SPACE STATION HIGHLIGHTS**

In FY 2003, the Space Shuttle program completed two missions (STS-112 and STS-113) to the ISS. Both missions delivered truss sections to the ISS, as well as crew and equipment translation aid carts, which can be used by space walkers to move equipment along the trusses (see Figure 29). In all, astronauts made three space walks to continue ISS construction. The ISS, now in orbit for nearly 1,800 days,



**Figure 29: Astronauts John Herrington and Michael Lopez-Allegria work on the newly installed Port-1 truss on the ISS.**



**Figure 30: In this artist's conception, the DART flight demonstrator (top left) is shown rendezvousing with the Multiple Paths, Beyond-line-of-Site Communications (MULBCOM) satellite (bottom right) in low Earth orbit.**

continues to provide a safe and reliable research facility in low Earth orbit. While construction of the ISS was scaled down following the *Columbia* accident, the onboard human presence and research continued uninterrupted thanks to agreements among the ISS’s international partners.

Source: <http://iss-www.jsc.nasa.gov/ss/issapt/prmo/gprametrics.htm>.  
Space Flight Enterprise

For more information on this activity, see Goal 8, APG 3H25, in Part 2 of this report.

**PLANNING THE NEXT GENERATION OF U.S. SPACE FLIGHT**

NASA is laying the foundation for the next generation of American space flight. NASA’s Orbital Space Plane (OSP) program is charged with creating a new crew rescue and transport vehicle that will assure access to the ISS and low Earth orbit. The OSP program includes technology programs such as the Demonstration of Autonomous Rendezvous Technology (DART) project, a flight demonstrator vehicle designed to test technologies required to locate and rendezvous with other spacecraft (see Figure 30). The DART mission will provide the first-ever autonomous rendezvous capability for the U.S. space program. In FY 2003, the DART

program completed major planning milestones and began hardware development.

Source: <http://www1.msfc.nasa.gov/NEWSROOM/news/releases/2003/03-145.html>.

Aerospace Technology Enterprise

For more information on this activity, see Goal 8, APGs 3SLI1, 3SLI2, and 3SLI3, in Part 2 of this report.

## EXPENDABLE LAUNCH VEHICLE ACHIEVEMENTS

NASA's ELV program provides access to space for many of NASA's satellites and experiments (see Figure 31). In FY 2003, the ELV program successfully delivered the following seven communication and research satellites to orbit:

- Tracking and Data Relay Satellite-J (TDRS-J);
- Ice, Cloud, and Land Elevation Satellite (IceSat)/Cosmic Hot Interstellar Plasma Spectrometer Satellite (ChipSat);
- Solar Radiation and Climate Experiment (SORCE);

- Galaxy Evolution Explorer (Galex);
- Mars Exploration Rover-A (MER-A);
- Mars Exploration Rover-B (MER-B); and
- Scientific Satellite Atmospheric Chemistry Experiment (SciSat).

The TDRS-J satellite, the second of three enhanced Tracking and Data Relay Satellites, will service the Space Shuttle, ISS, Hubble Space Telescope, and other Earth-orbiting satellites with improved communications and data relay services well into the 21st century.

Source: <https://extranet.hq.nasa.gov/elv/IMAGES/h.pdf>.

Space Flight Enterprise

For more information on this activity, see Goal 8, APG 3H3, in Part 2 of this report.



Figure 31: A Delta II ELV blasts a Mars Exploration Rover to the Red Planet.



**Goal 9:** Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.

*In FY 2003, NASA achieved two of three annual performance goals (APGs) under Goal 9. Significant progress in the remaining APG resulted in a “yellow” rating.*

How long can a human live and work in the space environment? How far can we venture from Earth? By understanding and countering the physical limitations to human space flight, NASA is gradually opening the frontier of space for exploration and discovery. Below are highlights of some of NASA’s significant activities for this Goal.

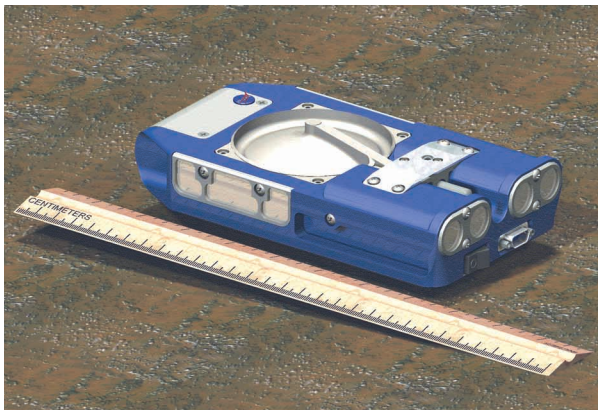
### **LIGHTENING THE LOAD—ADVANCES IN LIFE SUPPORT TECHNOLOGIES**

We need to reduce mass, volume, and crew time, while simultaneously increasing the reliability of human support systems, to enable humans to venture far beyond low Earth orbit. In FY 2003, NASA’s Advanced Human Support Technology program made significant strides toward achieving this aim by developing technologies that can nearly halve the system mass of future human life support systems compared with baseline technologies for the ISS. One example is the Electronic Nose (E-Nose), which is designed to monitor the air that astronauts breathe (see Figure 32). This same technology may one day be used to detect fires and chemical spills and to uncover diseases.

*Source: [http://spaceresearch.nasa.gov/research\\_projects/ahst.html](http://spaceresearch.nasa.gov/research_projects/ahst.html).*

Biological and Physical Research Enterprise

*For more information on this activity, see Goal 9, APG 3B2, in Part 2 of this report.*



**Figure 32: A mockup of a new electronic nose (E-Nose) that monitors astronauts’ air supply.**



**Figure 33: Astronaut Edward Lu exercises on the Cycle Ergometer with Vibration Isolation System (CEVIS) on the ISS.**

### **SOLVING HEALTH PROBLEMS IN SPACE AND ON EARTH—THE NASA-NSBRI PARTNERSHIP**

The National Space Biomedical Research Institute (NSBRI) is a consortium of 12 institutions working with NASA to prevent or solve health problems related to long-duration space travel and exposure to microgravity. Much of NSBRI’s research will also benefit humankind on Earth. NSBRI research highlights for this year include the following:

- Researchers identified early indications that nutritional supplements may reduce muscle atrophy brought on by space travel, prolonged bed confinement, or immobility.
- NASA developed new technology to characterize unknown bacteria. Its immediate application will be to identify bacteria in space, but it should eventually aid in diagnosing medical conditions and detecting biological hazards on Earth.

*Source: <http://www.nsbri.org/>.*

Biological and Physical Research Enterprise

*For more information on this activity, see Goal 9, APG 3B1, in Part 2 of this report.*

## USE IT OR LOSE IT—NEW INSIGHTS INTO THE MECHANISMS INVOLVED IN MUSCLE WASTING

Understanding how muscle wasting (atrophy) occurs in astronauts during space flight, and developing possible countermeasures, are critical both to our future in space and to battling disease on Earth (see Figure 33). In some muscular dystrophies, muscle degeneration is due to a defect in the structural stability of the sarcolemma, the thin membrane enclosing muscle fibers. New evidence suggests that disruption of membrane repair machinery also causes muscular dystrophy. This new insight may pave the way for better therapies and preventative tactics for the treatment of muscle loss in space and on Earth.

Source: [http://www.ncbi.nlm.nih.gov:80/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list\\_uids=12736685&dopt=Abstract](http://www.ncbi.nlm.nih.gov:80/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=12736685&dopt=Abstract).

Biological and Physical Research Enterprise

For more information on this activity, see Goal 9, APG 3B1, in Part 2 of this report.

## PACKING FOOD FOR A LONG FLIGHT—PHOTOSYNTHESIS AND METABOLISM OF SUPERDWARF WHEAT IN MICROGRAVITY

Future crews who undertake extended space flight will need a reliable, renewable food supply. To provide this, we must understand the effects of microgravity and the space environment on plants. Dwarf wheat plants successfully grown from seed aboard the ISS as part of the Photosynthesis Experiment Systems Testing and Operations (PESTO) experiment provided the first evidence that overall growth, photosynthesis, and transpiration are unaffected by space flight. The PESTO experiment was the first designed to study relatively long-term plant development on a space flight mission. An international team of scientists continues to analyze the multiple wheat samples on the cellular, molecular, and genetic levels.

Source: [http://spaceresearch.nasa.gov/research\\_projects/ros/bpspesto.html](http://spaceresearch.nasa.gov/research_projects/ros/bpspesto.html).

Biological and Physical Research Enterprise

## GOAL 10: Enable revolutionary capabilities through new technology.

In FY 2003, NASA achieved four of five annual performance goals (APGs) under Goal 10. Due to management decisions to cancel some programs, one APG was not achieved, and received a “white” rating.

NASA’s goal is to change the definition of what is technologically possible. Emerging fields like biotechnology, information technology, and nanotechnology hold great promise for expanding the frontier of space, and NASA is leading the way in their development and application.

NASA’s successes this year ranged from advanced technologies that will power future Mars rovers to improved supercomputing that could lead to better weather prediction. Below are highlights of some of NASA’s significant activities for this Goal.

### ION BATTERIES FOR MARS ROVERS

The journey to Mars is long and arduous. The robotic explorers that NASA sends to the Red Planet must be efficient and able to provide reliable power in harsh conditions. For these reasons, the Air Force and NASA funded Yardney Technical Products to develop space-qualified lithium ion batteries for future space applications. The Yardney batteries powering the two rovers that landed on Mars in 2004 are a quarter of the weight and half the volume of batteries used in past missions (see Figure 34). Through NASA’s Small Business Innovation Research (SBIR) program, NASA transferred this technology to a small business that now

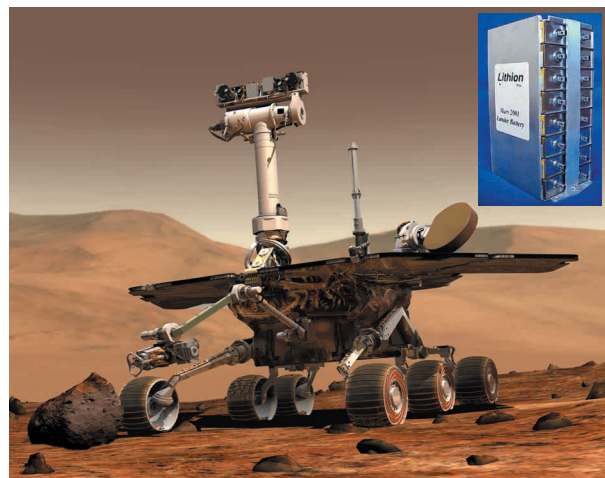


Figure 34: Yardney batteries (see inset) power the Mars Exploration Rovers.

furnishes the same types of batteries for use in other upcoming Mars missions.

Source: <http://sbir.gsfc.nasa.gov/SBIR/successes/ss/7-015text.html>.

Aerospace Technology Enterprise

## PUTTING THE “SUPER” IN SUPERCOMPUTING

NASA’s high-performance supercomputer “Chapman” is the first computer with a single-system image architecture in which all processors share a common memory (see Figure 35). Chapman increased the number of simulated climate days from 900 a day to more than 2,900 a day. This advance in computing capability resulted in previously unidentified climatic trends and associations with other events such as pollution. Chapman’s ability to perform simulations three times faster than previous computers is paving the way for better models and a greater understanding of Earth’s dynamic weather systems, ultimately leading to better weather forecasting capabilities.

Source: <http://www.aero-space.nasa.gov>.

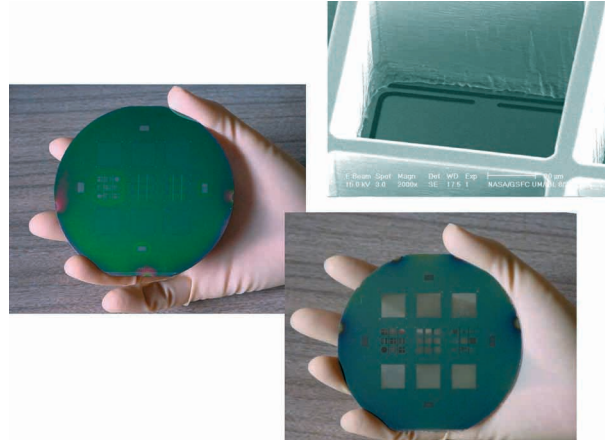
Aerospace Technology Enterprise



**Figure 35: The Chapman supercomputer triples climate simulation speeds.**

## LOOKING FAR INTO THE UNKNOWN

The Hubble Space Telescope enabled us to look deep into the cosmos, and NASA continues to develop technologies that will enable us to see farther still. In FY 2003, NASA developed a large prototype array of microshutters to direct



**Figure 36: A NASA microshutter prototype.**

light from multiple sources into astronomical instruments resulting in a clearer picture of distant objects (see Figure 36). The James Webb Space Telescope will use this advance in its Multi-Object Spectrometer instrument.

Source: <http://www.aero-space.nasa.gov>.

Aerospace Technology Enterprise

For more information on this activity, see Goal 10, APG 3R12, in Part 2 of this report.

## ADVANCES IN FLIGHT SIMULATION

This year, NASA continued to explore new technologies designed to enhance aircraft and spacecraft responsiveness and safety. NASA integrated an initial pilot station with a desktop version of the Advanced Concepts Flight Simulator, referred to as the miniACFS. This advance allows NASA and other users to demonstrate technologies that may be used by pilots in the future to provide safer operation and better flight control of aircraft under adverse conditions (e.g., damaged components). The technologies behind the miniACFS demonstrate intelligent and adaptive recovery systems and advances in communication architectures that will be used in new and anticipated aircraft, spacecraft, and robotic designs. The integration of an initial pilot station with miniACFS offers advances in more reliable and autonomous operations than previously achievable.

Source: <http://www.aero-space.nasa.gov>.

Aerospace Technology Enterprise



## Relation of NASA's Performance to Agency Strategic and Performance Plans

In FY 2003, NASA created a more robust link between its budget and performance planning and evaluation activities. Embracing the philosophy of "One NASA," the Agency released its *2003 Strategic Plan* ([http://ifmp.nasa.gov/codeb/docs/2003\\_Strategic\\_Plan.pdf](http://ifmp.nasa.gov/codeb/docs/2003_Strategic_Plan.pdf)) in February 2003, a plan that marked a tremendous step forward in making NASA's systems more consistent, measurable, and accountable.

The *2003 Strategic Plan* focuses on the ten Agency Goals and introduces NASA's new budget structure (18 Themes) designed to achieve those Goals. Consistent with that plan, the performance sections of this report are organized according to the ten Agency Goals.

To ensure consistency between the FY 2003 and FY 2004 budget and performance goals, NASA remapped the *FY 2003 Performance Plan* to correspond to the new strategic plan's framework and theme structure (<http://ifmp.nasa.gov/codeb/docs/FY03PerformancePlanRemapped.pdf>). NASA undertook this exercise to recognize our new strategic framework and to ensure that this *FY 2003 Performance and Accountability Report* will better portray how we are progressing towards our Goals and objectives. Therefore, to move NASA toward its overarching Goals, different organizations within the Agency worked toward more than 100 annual performance goals (APGs) in FY 2003. However, since the original FY 2003 budget was structured around the Agency's Enterprises, the financial statements included in this report still represent the Enterprise-based budget structure that NASA will leave behind as it embraces the new full-cost Theme-based structure in FY 2004. The work NASA did in FY 2003 completed the foundation for the full integration of performance-based budgeting in FY 2004.

For more information on NASA's budget and performance planning system, please refer to Appendix III.

## Strategies and Resources Used by NASA to Achieve its Performance Goals

NASA's Vision and Mission guide its investments in programs and activities that will achieve its Goals. NASA's performance planning process begins with the Vision and Mission and flows to more detailed multi-year outcomes and APGs. (See Figure 37 for a diagram of the performance planning process flow.)

NASA identifies near-term strategies, tactics, and activities to achieve the Agency's long-term Goals and objectives included in our strategic plan. The performance goals and objectives appear in an annual agency performance plan, and we report our progress in achieving these Goals and objectives in our annual performance and accountability report.

## Management Procedures to Ensure Relevant and Reliable Performance Information

To measure performance, both the annual performance plan and the annual performance and accountability report use the same basic unit: the APG. Lower-level measures called performance indicators help determine whether we have met each APG. Much of our work relies on discovery and innovation, so many of our performance indicators are activities that have never been performed before and the chances of success are difficult to estimate. For this reason, we sometimes set APG achievement levels equal to the achievement of a certain proportion of indicators. While we may not expect to achieve all of the indicators or even know which of them will produce the most important results, we

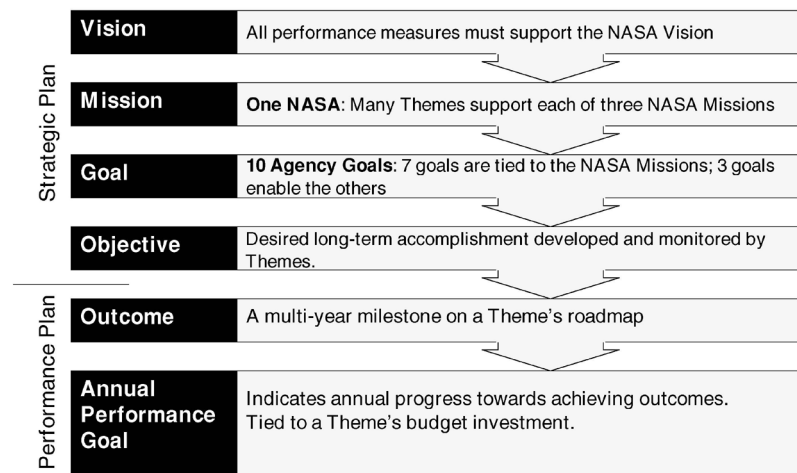


Figure 37: NASA's performance planning process flow.

know that in achieving most of them, we will make significant progress toward accomplishing our APG and long-term Goals.

To rate the progress on our performance plan goals, a color code is assigned to each APG by NASA program personnel and/or external reviewers (see *Table 2*).

<b>Performance Rating</b>	<b>Performance Rating Parameters</b>
<b>Blue</b>	Significantly exceeded annual performance goal.
<b>Green</b>	Achieved annual performance goal.
<b>Yellow</b>	Failed to achieve annual performance goal, progress was significant, and achievement is anticipated within the next fiscal year.
<b>Red</b>	Failed to achieve annual performance goal, completion within the next fiscal year is not anticipated, and target may be infeasible or unachievable.
<b>White</b>	Annual performance goal postponed or cancelled by management directive.

**Table 2: Performance rating parameters.**

## **NASA's Performance Trends**

In FY 2002, NASA achieved 89 percent of its APGs. This year, NASA achieved 83 percent of the APGs set forth in our annual performance plan. A major factor in this decline was the *Columbia* accident and the subsequent grounding of the Shuttle fleet.

Detailed trend information for all of the APGs is included in Appendix I. The trend data is organized by Theme and objective to make them traceable to the Agency's Goals and budget structure. Presenting the trend data by Theme allows NASA to track our annual performance in preparation for our move to full budget and performance integration in FY 2004.

# FY 2003 Financial Highlights

NASA's financial statements were prepared to report the financial position and results of operations of the Agency, in accordance with generally accepted accounting principles as defined by *The Chief Financial Officer's Act* of 1990. While these financial statements were prepared from the books and records of NASA in accordance with formats prescribed by the Office of Management and Budget, they are in addition to financial reports prepared from the same books and records used to monitor and control budgetary resources. The statements should be read with the realization that NASA is a component of the U.S. Government, a sovereign entity.

## Assets, Liabilities, and Cumulative Results of Operations

The Consolidated Balance Sheet reflects total assets of \$46.9 billion and liabilities of \$3.9 billion for FY 2003. Unfunded liabilities reported in the statements cannot be liquidated without legislation that provides resources to do so. About 82 percent of the assets are property, plant, and equipment (PP&E), with a book value of \$36.6 billion. PP&E is property located at the Centers, in space, and in the custody of contractors. Almost 78 percent of PP&E consists of assets held by NASA, while the remaining 22 percent is property in the custody of contractors. The book value of assets in space, various spacecraft operating above the atmosphere for exploration purposes, constitutes \$17.9 billion, or 63 percent, of NASA-owned and -held PP&E.

Cumulative Results of Operations represents the public's investment in NASA, akin to stockholder's equity in private industry. The public's investment in NASA is valued at \$38.7 billion. The Agency's \$43 billion net position includes \$4.3 billion of unexpended appropriations (undelivered orders and unobligated amounts or funds provided but not yet spent). Net position is presented on both the Consolidated Balance Sheet and the Consolidated Statement of Changes in Net Position.

## Net Cost of Operations

The Statement of Net Cost is designed to show separately the components of the net cost of NASA's operations for the period. In FY 2003, NASA implemented its Mission through six strategic Enterprises. The total net costs in FY 2003 were: Human Exploration and Development of Space, \$5.2 billion; Space Science, \$2.8 billion; Earth Science, \$1.3 billion; Biological and Physical Research, \$1.3 billion; Aerospace Technology, \$1.2 billion; and, Education Programs, \$0.17 billion. Net cost is the amount of money NASA spent to carry out programs funded by Congressional appropriations.

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# Management Controls, Challenges, and Actions

## Administrator's Statement of Assurance

In response to recommendations of the NASA Internal Control Council (ICC), and the results of the financial statement audit process, one material weakness reported in FY 2002 will remain open and one new material weakness was identified during FY 2003. NASA has taken aggressive measures to close the material weakness identified in FY 2002: the Agency's deficiency in management of property, plant and equipment (PP&E), and Materials. The new material weakness, designated as Space Shuttle, is a qualified control deficiency. NASA accepted all 29 recommendations of the *Columbia* Accident Investigation Board (CAIB). Corrective and preventive actions are proceeding rapidly; and we are addressing cultural changes to regain the Agency's long-standing reputation for accountability. We developed an Implementation Plan for Return to Flight and Beyond, and an independent task group is assessing the effectiveness of NASA's response to the CAIB recommendations.

The NASA team led by the Office of the Chief Financial Officer, supported by the Office of Procurement, Office of Management Systems, and others at Headquarters and our Centers, has made significant progress towards eliminating the material weakness. The responsible NASA officials will continue to report regularly on PP&E and Materials to the ICC at quarterly progress meetings in FY 2004. The description of PP&E and Materials in this report provides a summary of significant corrective actions taken. I therefore submit a qualified Statement of Assurance as prescribed by the *Federal Managers' Financial Integrity Act* (FMFIA).



Sean O'Keefe  
NASA Administrator

# Systems, Controls, and Legal Compliance

## SYSTEMS

NASA uses two key automated systems to provide NASA-wide information on the status of key management actions. The first, the Corrective Action Tracking System (CATS II), tracks, completes, and closes all recommended actions resulting both from audits and from the major management reviews described below. CATS II provides a current, clear picture of the state of our management actions and controls. The second system, the NASA Online Directives Information System (NODIS), provides official information for the overall governance and control of NASA's operations. NODIS' electronic document generation system and library is accessible to all employees and contains all of the Agency's policies, procedures, and guidelines.

In FY 2003 NASA made significant progress toward full cost management through the implementation of the Integrated Financial Management (IFM) program Core Financial (CF) module. More information on IFM and CF can be found in "NASA's Response to Major Management Challenges in High-Risk Areas" and "The President's Management Agenda" sections of this report.

## CONTROLS

NASA's strong management controls include the Internal Control Council (ICC), which meets quarterly to discuss material weaknesses and major management challenges facing the Agency. The ICC agrees on corrective actions for identified problems and tracks them through to completion. The highest levels of NASA senior management serve on the ICC and on the many other Agency boards and councils that contribute to internal management controls. External auditors from the Office of Inspector General (OIG) and the General Accounting Office (GAO) also make recommendations to the Agency on a continuous basis. NASA responds to the recommendations and closely monitors the activities to address them.

NASA's internal controls have significantly improved through the corrective actions implemented by senior management. NASA's commitment to accountability shows in our efforts to: establish reasonable controls, and continually examine recommendations for their improvement, make sound determinations on corrective actions, and verify and validate the results. This commitment is further evidenced by the

many control improvements and significant management initiatives taken by NASA leadership in response to law, the President's Management Agenda, GAO standards and audits, Office of Management and Budget (OMB) guidance, OIG recommendations, and collaborative efforts to make the vision of "One NASA" a reality. Detailed descriptions for some of these actions are included in this volume under NASA's Response to Major Management Challenges and High-Risk Areas.

## LEGAL COMPLIANCE

NASA is in full legal compliance with the *Federal Manager's Financial Integrity Act* (FMFIA) as documented in the Statement of Assurance included in this section. Specific information on NASA's compliance with the FMFIA is in the following pages.

During FY 2003, NASA implemented a new off-the-shelf integrated financial management system—the SAP/R3 Core Financial Module. Prior to this implementation, NASA had ten separate, non-integrated financial systems, one at each NASA Center. As a result of this operating environment, and as reported by the NASA Inspector General and our external auditors, NASA did not have a single integrated financial management system that provided management with accurate, timely, and useful information.

During FY 2003, that operating environment changed with NASA fully implementing IFM Program Core Financial Module, SAP R/3 at all ten NASA Centers. SAP R/3 was certified by the Joint Financial Management Improvement Program (JFMIP) as meeting the Federal financial management systems requirements. SAP R/3 is a transactional-based system that records almost all financial transactions at the account detail level required by the U.S. Standard General Ledger and allows NASA to view information in one consistent manner throughout the Agency.

As a result of this exception, NASA financial management system, SAP R/3, does not comply substantially with the *Federal Financial Management Improvement Act* (FFMIA).

# Integrity Act Material Weaknesses and Non-Conformances

## EXISTING MATERIAL WEAKNESS

### NASA Property, Plant, and Equipment and Materials

NASA will continue to report a material weakness in property plant and equipment (PP&E) and Materials that was first identified in the *FY 2002 Performance and Accountability Report*. During FY 2003, NASA implemented corrective actions and made significant progress towards remedying this weakness. NASA will continue to track this management control deficiency, and it will be monitored and assessed internally by the ICC for effectiveness and sustainability of corrective actions.

With the support and direction of the Deputy Administrator, NASA took corrective actions to improve the financial reporting of PP&E and Materials for FY 2003. Of NASA's largest 55 PP&E contracts, the Offices of the Chief Financial Officer and Procurement initiated a working group of contractors to implement changes for better control and improvement of PP&E reporting. Completed actions include: required quarterly reporting of property data from the top 55 contracts; amendments of all contracts for accelerated year end property reporting; strengthened inventory and documentation requirements; and increased guidance issued to NASA and contractor personnel. Further, to improve reporting consistency in two different property areas, NASA staff revised policy for work in process pertaining to assets in space and software capitalization thresholds. The revised policy was completed, issued, and available for reference and use across the Agency.

In FY 2004, NASA will implement internal controls to ensure full compliance with the revised policies.

## NEW MATERIAL WEAKNESS IDENTIFICATION

### Space Shuttle

The CAIB Report identified a number of systemic cultural, organizational, and managerial issues within both the Space Shuttle program and NASA as a whole that contributed to the loss of *Columbia* on February 1, 2003. Fifteen return to flight and 14 continuing to fly recommendations are in the CAIB Report. Four recommendations dealt explicitly with management issues, and many of the other recommenda-

tions have important organizational as well as technical implications. The CAIB Report also calls on NASA to prepare a detailed plan for defining, establishing, transitioning, and implementing these recommendations prior to return to flight, with the understanding that the implementation of the fundamental management changes will continue beyond the first Shuttle flight after *Columbia*.

In response to the CAIB report, NASA developed the *Implementation Plan for Return to Flight and Beyond*. The implementation plan is an evolving blueprint for safely and reliably returning to flight. It explains how NASA is complying with the recommendations of the CAIB and other corrective actions. These additional corrective actions may include other CAIB observations, self-imposed Shuttle program initiatives, or input from other sources. NASA also is in the process of determining the full spectrum of recommended return to flight hardware and process changes required prior to return to flight. The precise implementation of these initiatives will evolve as NASA continues to assess the long-term and far-reaching implications of these recommendations.

An independent task group, chaired by former astronauts Thomas P. Stafford and Richard P. Covey, will report directly to the NASA Administrator on the progress of NASA's response to all of the CAIB recommendations. The group also will make other observations on safety and operational readiness to ensure accountability, quality, and control.



National Aeronautics and  
Space Administration

**Office of Inspector General**  
Washington, DC 20546-0001



JAN 28 2004

TO: A/Administrator  
FROM: W/Inspector General  
SUBJECT: Most Serious Management and Performance Challenges

These are our views, pursuant to the Reports Consolidation Act of 2000, of NASA's most serious management and performance challenges. These challenges include areas where Agency management is working to improve programs, financial management, controls over assets and information technology, and the utilization of NASA facilities. While not new, the challenges will need to be reconsidered in the context of the President's new vision for space exploration, which will lead to termination of some existing programs and a transition to new ones. The six challenges are listed below and summarized in the enclosure.

- Addressing the serious cultural, organizational, and programmatic deficiencies that impact the safety and effectiveness of Shuttle operations.
- Achieving U.S. Core Complete on the International Space Station considering the uncertain timing of Space Shuttle operations.
- Ensuring that the integrated financial management system: improves NASA's ability to allocate costs to programs, efficiently provides reliable information to management, and supports compliance with the Chief Financial Officers Act.
- Designing and implementing adequate internal controls so information on NASA-owned, contractor-held property is reliable and complete.
- Continuing Agency efforts that will enhance information technology security by addressing weaknesses in controls.
- Ensuring that NASA's facilities are efficiently used and contribute to fulfillment of the Agency's mission.

We deleted the following challenge that was included on our list last year: "Obtaining the personnel authorities and tools needed to sustain a workforce that can accomplish the NASA mission now and in the future." Most of NASA's concerns about human resources are currently related to the organizational and cultural changes that the Columbia accident

and return-to-flight activities necessitated. In addition, certain human resources authorities and capabilities were granted to NASA through the Department of Homeland Security appropriation.

If you have any questions, or need additional information, please feel free to call me at 358-1220.



Robert W. Cobb

Enclosure

# Office of Inspector General Summary of Serious Management Challenges

## NASA'S MOST SERIOUS MANAGEMENT AND PERFORMANCE CHALLENGES

### **Addressing the serious cultural, organiza- tional, and programmatic deficiencies that impact the safety and effectiveness of Shuttle operations.**

The *Columbia* Accident Investigation Board (CAIB) report contains numerous and significant findings, recommendations, and observations on the Shuttle Program. The report, among other things, addresses serious cultural, organizational, and programmatic deficiencies that impact the safety and effectiveness of Shuttle operations. Implementation of the recommendations will require extensive effort by the Agency.

NASA established a Return To Flight (RTF) Planning Team designed to help the Shuttle Program plan as well as implement the CAIB recommendations. Also, the Administrator established an RTF Task Group for assessing NASA's actions to implement the CAIB recommendations as they pertain to the safety and operational readiness of the next Shuttle launch, STS-114. NASA has substantial work to perform to address concerns the CAIB raised and ensure that the Shuttle is ready for a return to flight.

The Agency will also need to ensure that the reconstituted Shuttle Program maintains a focus on safety and effectiveness as the program is phased out under the President's new vision for space exploration. The safe return to flight and continued operation of the Shuttle fleet will be a critical and massive undertaking for the Agency.

### **Achieving U.S. Core Complete on the International Space Station considering the uncertain timing of Space Shuttle operations.**

The Agency took positive steps to address problems with cost growth, cost estimating, and program management and then developed a corrective action plan for restoring confidence in NASA's ability to manage the International Space Station (ISS) Program. However, uncertainties about the timing for returning the Shuttle fleet to flight and resuming serv-

icing missions for the ISS will pose formidable challenges for achieving U.S. Core Complete and managing the ISS Program's schedule and cost.

Because the core complete milestone slips further for each day the Shuttle fleet is grounded, the Program schedule is currently delayed more than a year, and the cost impact will likely be significant. In a September 12, 2003, report the General Accounting Office (GAO) concluded that a number of factors will likely result in increased costs—costs that include maintaining and storing station components and extending contracts. GAO also noted that important decisions affecting international partner funding and agreements were delayed. NASA officials stated that it was too soon to determine the magnitude and costs of delayed assembly and implications of the CAIB's recommendations.

The Agency will also need to ensure that the ISS Program maintains a focus on safety and effectiveness if American funding and participation is phased out as currently planned under the President's new vision for space exploration.

### **Ensuring that the integrated financial management system: improves NASA's ability to allocate costs to programs, efficiently provides reliable information to management, and supports compliance with the Chief Financial Officers Act.**

During FY 2003, NASA implemented the Core Financial Module of the Integrated Financial Management Program (IFMP) to replace 10 different legacy accounting systems. Implementation of the module was intended, among other things, to eliminate weaknesses identified in prior year financial statement audits. However, NASA had difficulty with the preparation of the interim and year-end FY 2003 financial statements, which resulted in a disclaimed opinion on the FY 2003 financial statements by the independent auditor conducting the audit. Also, GAO identified significant problems with NASA's new financial management system. In our opinion, NASA's ability to prepare auditable financial statements and meet the Office of Management and Budget (OMB) accelerated reporting deadline of November 15, 2004, is in jeopardy.

The FY 2003 year-end financial statements were not provided to the independent auditor until December 10, 2003, nearly 6 weeks after the original deadline. Despite the delay, the financial statements contained obvious errors and raised questions that management could not readily answer. One

significant question involved the accuracy of the amount reported as the Agency's Fund Balance with the Treasury. Detailed testing in the area found that the Agency could not readily demonstrate that reconciliations were performed correctly or adequately reviewed by NASA financial management staff. The Fund Balance with the Treasury issue, problems with data conversion from the 10 legacy accounting systems, issues associated with prior period adjustments to contractor-held property, along with the delay in providing the financial statements, caused the independent auditor to conclude that significant weaknesses existed in the overall control environment and that the financial statement audit could not be completed by the required OMB deadline of January 30, 2004.

We completed three audits of the Agency's IFMP core financial system. In those audits we reported that NASA had not developed a plan to resolve complex accounting issues and configure its Core Financial Module to adequately support full cost accounting. We also reported that the Agency had not planned to test and resolve all transactions, reports and testing discrepancies prior to full, NASA-wide implementation of the Core Financial Module.

In a series of reports issued in November 2003, GAO concluded that the IFMP is at risk of schedule delays and cost growth because of the uncertain reliability of NASA's costs estimates, optimistic schedules, and an insufficient process for ensuring the adequacy of funding reserves. GAO stated that (1) the IFMP's life-cycle cost estimate did not include the full costs likely to be incurred, and (2) program challenges may impact the scheduled FY 2006 implementation of the remaining modules. GAO also concluded the IFMP does not provide many key external financial reporting capabilities. Specifically, NASA had not converted the system to support full cost accounting and deferred implementation of key Core Financial Module capabilities for making adjustments to prior year obligations and recording property and materials. In addition, NASA's implementation approach created problems in recording accounts payable, accrued costs, and obligation transactions.

**Designing and implementing adequate internal controls so information on NASA- owned, contractor-held property is reliable and complete.**

NASA's controls over contractor-held property, plant, and equipment are weak and do not ensure that information provided for inclusion in the financial statements is reliable and

complete. NASA's independent auditor cited for the third year in a row the lack of adequate controls over contractor-held property as a material weakness in internal controls in the audit of the FY 2003 financial statements. GAO also identified weaknesses in NASA's controls over property and materials.

Year-end reporting by the contractors resulted in adjustments to the current and prior year property and equipment amounts. Significant adjustments to amounts previously reported in FY 2003, along with adjustments to FY 2002 amounts, indicate that controls still need substantial improvement. Controls at the contractors must be enhanced to ensure accurate and complete property reporting and to keep adjustments for all reporting periods to a minimum. To ensure that contractors' reports are accurate, complete, and consistent with Agency policies and procedures, NASA must improve its controls.

In November 2003, GAO reported that NASA has not reengineered processes to account for property and materials held by contractors. Despite completing installation of the new Core Financial Module in June 2003, GAO found contract costs related to property and materials were not captured at the transaction level. Instead, NASA continues to rely on summary level reports, manual reviews, and journal entries to update the general ledger. As a result, NASA cannot link expenditures and accrued costs with specific equipment being constructed. GAO recommended that NASA implement a corrective action plan to record activity related to contractor-held property at the transaction level.

**Continuing Agency efforts that will enhance information technology security by addressing weaknesses in controls.**

NASA's leadership has implemented several information technology security (ITS) improvements and is formulating plans to address many of the ITS weaknesses that were identified by our audits and assessments. We believe that these positive changes should help improve NASA's overall ITS posture. While management has recognized various concerns, many ITS challenges remain. We found significant recurring internal control weaknesses related to ITS, including inadequate compliance with Federal and NASA ITS requirements including system administrator training, host and network security, physical security, contingency plan testing and alternate processing facilities, and incident response capability.

In addition, the independent auditor for NASA's FY 2003 financial statements identified several ITS deficiencies relating to the general control environment over the IT architecture that processes financial applications. The independent auditor's FY 2002 financial statement audit identified similar ITS deficiencies.

**Ensuring that NASA's facilities are efficiently used and contribute to fulfillment of the Agency's mission.**

NASA owns more than 5,400 buildings and other structures and more than 40,000 hectares of land. Many facilities are aging, and funding has not been sufficient to keep the facilities in good repair. To address these issues, NASA formed a Facilities Tiger Team. The Team determined that the current condition of NASA facilities is poor and deteriorating and that the current process for funding facility construction, maintenance, and repair needs improvement. The Team made recommendations for improving the funding process for facilities management. The Team also recommended that an analysis be performed that compares NASA program and mission requirements to existing real property and identifies opportunities for consolidations, facility disposals, and other facility uses. A contractor is helping develop a real property business plan for the Agency. The plan lists numerous opportunities for NASA to improve the management of its facilities and land.

Implementation of the Facilities Tiger Team recommendations and serious consideration of the opportunities identified in the real property business plan are important steps in ensuring that adequate facilities exist to meet Agency needs.

# NASA's Response to Major Management Challenges and High-Risk Areas

In FY 2003, NASA continued to address specific issues raised by the General Accounting Office (GAO) and the Office of the Inspector General (OIG). The GAO's January 2003 report, *Major Management Challenges and Program Risks: NASA* (GAO-03-114), and the OIG letter (dated October 6, 2003) about NASA's most serious management challenges, addressed NASA's 14 major management challenges and high-risk areas. The following discussions respond to each of the GAO and OIG issues with the exception of the International Space Station (ISS) where we have provided a single, combined GAO/OIG response.

## STRATEGIC HUMAN CAPITAL MANAGEMENT

In GAO-03-114, GAO recognized that NASA has improved the Agency's human capital management processes. GAO specifically cited progress through the creation of the NASA Strategic Human Capital Plan (SHCP), the Agency-wide Competency Management System (CMS), then in development, NASA's human capital-related legislative proposals, and renewed hiring. Since GAO-03-114 was issued, NASA has made further progress. We implemented the SHCP initiatives. We deployed the CMS across the Agency and are further enhancing the system. We used CMS data to identify "at risk" competencies and to target Fall 2003 recruitment efforts. We worked closely with the House Science and Government Reform Committees and the Senate Governmental Affairs Committee on human capital-related legislative provisions to give NASA greater flexibility in addressing both our existing skills and demographic imbalances and our leadership challenges. We are analyzing the results of Office of Personnel Management's (OPM) Government-wide survey to identify opportunities to enhance NASA's human capital strategies and programs. NASA's scores on the OPM survey were among the highest in the government. In addition, we revitalized Agency-level leadership development programs and, based on the results of a recent mobility study, we are piloting actions to expand developmental exchange activities across Centers and between Centers and Headquarters. We established a human capital accountability self-assessment system and are measuring progress in the strategic management of human capital against the standards in the system using survey and data systems NASA-wide.

## INTERNATIONAL SPACE STATION PROGRAM MANAGEMENT

The President's *FY 2002 Budget Blueprint* outlined the management and cost control reforms needed to demonstrate fiscal credibility and restore public confidence. The blueprint specifically directed that an external management and cost control review of the ISS program be undertaken, that program management reporting be shifted from the program's Lead Center to NASA Headquarters, and that the Agency search for innovative ways to improve management and lower station costs.

In November 2001, the independent ISS Management and Cost Evaluation (IMCE) Task Force reported its recommendations to NASA. Included in the recommendations were measures to expand Headquarters oversight of program performance; improve the quality and availability of data needed for proper program management; define and document the program's baseline; verify the costs to complete and operate the ISS; and take advantage of all opportunities to enhance ISS research capabilities.

In response, NASA executed a five-point management strategy to:

- 1 Establish an integrated research portfolio that maximized the benefits of space-based research within available resources;
- 2 Develop the management structure and roadmap for achieving the U.S. Core station within budget and schedule;
- 3 Implement improvements to program cost estimating and cost control methods, tools, and controls to regain credibility and improve financial forecasting;
- 4 Preserve critical path items for potential post-U.S. Core options to increase research capability while maintaining safety as the first priority; and
- 5 Maintain cooperative international efforts to achieve the U.S. Core station and an enhanced configuration that meets research and international utilization requirements.

To measure progress toward executing this strategy, NASA and OMB agreed on a set of ISS Success Criteria. NASA was required to demonstrate improved management and program performance before any consideration would be given to enhanced configuration. Over the past two years, NASA has complied with all of the recommendations made by the IMCE Task Force, and has satisfied all of the OMB/NASA success criteria levied, re-establishing management and cost control credibility.



The ISS program continues to be listed as a management challenge due to the programmatic impacts of the Shuttle grounding. The long-term impacts cannot be determined until the Shuttle returns to flight. Russian Progress and Soyuz vehicles continue to supply and transfer crews to the ISS. Limited science onboard the ISS also continues.

## **REDUCING SPACE LAUNCH COSTS**

In November 2002, NASA initiated a major change to the Integrated Space Transportation Plan (ISTP). Space Shuttle safety upgrades and the ISS were augmented to make each viable and credible from a management perspective. Programmatic content and remaining funding for the Space Launch Initiative (SLI) program were divided between two specific space transportation programs. All SLI space transportation technologies were integrated with the Advanced Space Technology program, creating the Next Generation Launch Technology (NGLT) program. The crew rescue, crew return, and crew transfer missions to the ISS were assigned to the Orbital Space Plane (OSP) program.

The new ISTP provides a focus and a framework for meeting the launch system cost challenges addressed in the GAO's January 2003 report GAO-03-114. Specifically, ISTP included the following:

- Direction to the OSP program to use existing or near-term technologies only, significantly reducing overall risk;
- A straightforward and limited set of Level 1 baseline requirements; and
- An independent (outside the program) OSP Cost Credibility Team and a decision point in FY 2004 to consider initiating a launch system technology risk reduction program under the NGLT program. (This decision will address the new launch system requirements, DoD participation, and credible cost estimates.)

## **PROCUREMENT/IMPROVING CONTRACT MANAGEMENT**

Included in the OIG's FMFIA input is a recommendation to include procurement as a management challenge. Over the past several years, GAO identified NASA contract management (included in the broad area of procurement) as high-risk for several reasons: past delays in implementing the Integrated Financial Management (IFM) system; and use of full cost accounting; and continued reliance on undefinitized change orders. In FY 2003, NASA made significant progress in addressing these GAO concerns—so much so that the only concern not fully resolved is IFM.

The OIG did address IFM in its FMFIA input, and we continue to make progress in implementing the IFM system in a phased manner across the NASA Centers. In June 2003, we successfully completed Agency-wide implementation of the Core Financial (CF) module. With this step complete, NASA became the first Federal agency to implement a commercial Enterprise Resources Planning system across the entire organization. By eliminating 140 disparate legacy financial systems and implementing a single instance of a "COTS" product, NASA saw improvements in the timeliness, usefulness, reliability of, and access to financial and contract data.

The CF module is considered the "engine under the hood" of NASA's full cost efforts. The robust capabilities of the IFM system links projects with all their direct costs, such as supplies and materials, contracts, service pools, and civil service salaries with those costs that cannot be traced to specific activities (i.e., indirect costs). FY 2003 was a transition year to the CF module. NASA currently is enabling full cost capabilities to begin in FY 2004. Using the CF module for full cost management, program and project managers will have control of and visibility into all their costs. This ability will give managers greater freedom to acquire and manage their resources and make decisions, and it will provide senior management with clearer lines of accountability and performance measurement.

In its FMFIA input, the OIG states that NASA continues to be challenged in promoting competition in contracting and in improving contract administration. Three programs skew the overall percentage of dollars competed: the Shuttle program, ISS, and the Jet Propulsion Laboratory. Exclusion of these programs results in NASA competing almost 90 percent of

all dollars awarded. (In the case of the Shuttle program and ISS, the Administrator made the decision not to compete these programs, and Congress concurred, citing a public interest exception.)

## **INFORMATION TECHNOLOGY SECURITY**

The Information Technology Security (ITS) threat continues to grow and we will always have issues and problems. The question is how good we are at identifying and responding to those weaknesses. NASA has processes and procedures and has been working hard to refine those processes, as well as bring our existing policies and procedures in line with changes made at the Federal level and changes in technology. To date, NASA has relied on self-verification that existing policies and procedures were being adhered to. This is an area where we have made changes, moving from three third-party independent ITS reviews a year to six a year, and establishing an Information Security Assurance Officer (ISAO) to conduct spot checks in addition to relying on the OIG to perform ITS audits. These reviews, along with newly established metrics, will help to ensure that performance is better aligned with policy and procedures.

NASA will continue to work to validate performance against policy and guidance by using independent third-party reviews, the ISAO, and OIG. NASA recognizes the partnership between the OIG and NASA as critical to ensure that the ITS environment improves and grows to meet an ever-increasing threat situation. A number of changes have been made in FY 2003 and will be accomplished in FY 2004. NASA is working closely with the OIG to enlist the organization's help in tackling improvements in existing policy and procedures, supporting new initiatives, and developing new policies and procedures.

## **LAUNCH VEHICLES: SPACE SHUTTLE**

In October 2003, the OIG recommended that the Internal Control Council (ICC) recognize the Space Shuttle as a material weakness. In accordance with the Administrator's Statement of Assurance, NASA has accepted this recommendation. The Final Report of the CAIB identified a number of systemic cultural, organizational, and managerial issues within both the Space Shuttle program and NASA as a whole that contributed to the loss of *Columbia* on February 1, 2003. For more information on NASA's response to this management challenge, see the New Material Weakness Identification narrative under the Integrity Act Material Weaknesses and Non-Conformances section.

## **CONTRACTOR HELD PROPERTY**

In December 2002, the OIG cited Contractor Held Property as a material weakness. In October 2003, the OIG cited Contractor Held Property as an other weakness (no longer a material weakness) based on several corrective actions that reduced the risk of inadequate internal controls. NASA will continue to track, monitor, and report on this issue as an other weakness.

With the support of the ICC under the direction of the Deputy Administrator, NASA took several corrective actions to improve the financial reporting of property, plant and equipment (PP&E) and Materials for FY 2003. For more information on NASA's response to this deficiency, see the narrative under the Integrity Act Material Weaknesses and Non-Conformances section.

## **FINANCIAL MANAGEMENT SYSTEMS**

Prior to the implementation of NASA's Integrated Financial Management (IFM) program Core Financial (CF) module, NASA had separate, non-integrated financial systems at each of our ten Centers. NASA did not have a single, integrated, Agency financial management system that could provide management with accurate, timely, and useful information.

In June 2003, NASA fully implemented the IFM program CF at all NASA Centers. The CF module, a SAP R/3 software product, was certified by JFMIP. CF is a transactional-based system that records all financial transactions at the detailed U.S. Standard General Ledger account level, allowing NASA to view information in one consistent manner throughout the Agency on a real-time basis.

## **FULL-COST MANAGEMENT**

The objective of full cost management is to establish the true mission costs of programs and activities enabling NASA managers and other users of financial information to make reliable business decisions when performing critical work with fewer resources. NASA will use the IFM program to implement and operate full cost management.

NASA has fully implemented full cost management, but the IFM program budget formulation module is not scheduled for completion until February 2004. Until then, NASA will continue to use alternative, and sometimes less effective, procedures to develop budgets for its programs.

## **OPEN OIG AUDIT RECOMMENDATIONS**

In October 2003, the Agency's ICC maintained open OIG recommendations as an "other" weakness, because the number of open recommendations is still an issue that requires visibility. NASA Senior Management is giving significant attention to open OIG recommendations, and all levels of management are working cooperatively with the OIG to improve coordination on audit follow-up. As a result of these efforts, the Agency reduced the number of open OIG recommendations from a high of 495 in November 2001 to a current level of 158. In addition, the Agency worked with the OIG to completely eliminate all unresolved recommendations as of September 30, 2003.

As part of the process to reduce the number of open recommendations, NASA management and the OIG developed new procedures for dealing with recommendations on which the estimated date of completion has passed, but corrective action is incomplete. Under the process, the organization responsible for the recommendation will request an extension from the Deputy Administrator with subsequent concurrence from the OIG. In addition, the OIG provides a weekly listing of expired recommendations and works with management to reconcile recommendation data in their respective systems.

Finally, expired recommendations remain a concern since some organizations have not made timely requests for extensions. Management and the OIG continue working together to develop new procedures, with the goal of driving the number of expired recommendations to zero.

## **LAUNCH VEHICLES: SPACE LAUNCH INITIATIVE**

NASA concurs with the need to ensure that proper management controls are in place for future space launch efforts. Specifically, the ICC, chaired by the Deputy Administrator, has determined that the Orbital Space Plane (OSP) program should be designated and tracked as a management challenge. The Office of Aerospace Technology will report quarterly to the ICC on the program's status.

Based on the OIG recommendation, NASA has taken steps to improve management of the OSP program in several key areas. For example, NASA understands that elements of cost were not included in earlier estimates developed for the Space Launch Initiative, and that moving forward with the OSP program requires complete and credible cost estimates. NASA has already initiated significant improvements to the cost estimating process, and all current and future

OSP program estimates will include all expected costs. Additionally, NASA understands that the risk management processes appropriate for the Space Launch Initiative technology risk reduction program are not adequate for the OSP full-scale development program. NASA has selected the database currently utilized by the ISS program as the one that will meet the requirements of OSP.

## **SAFETY AND MISSION ASSURANCE**

In response to the CAIB's findings and recommendations, the Administrator announced the establishment of the NASA Engineering and Safety Center (NESC) at the Langley Research Center. The specific roles and responsibilities of the NESC are not yet firmly established, and the NESC relationship to the CAIB-recommended "Independent Technical Engineering Authority" is pending definition. NASA must still further improve its safety practices in all areas related to human space flight, and safety will always be a significant challenge for the Agency.

## Looking Forward

For more than 45 years, NASA has been the world's preeminent leader in space and aeronautics research. Every opportunity to explore and discover is embraced as a challenge by NASA's committed workforce, and every challenge embraced affords NASA the unique opportunity to transform the world for all humankind.

As the Nation embarks on its second century of flight, NASA's Mission is buoyed by the Administration's new vision for the U.S. space exploration program. The fundamental goal of this new vision is to advance U.S. scientific, security, and economic interests through a robust space exploration program. This will require that NASA develop and implement an integrated, long-term robotic and human exploration program structured with measurable milestones and executed on the basis of available resources, accumulated experience, and technology readiness. NASA looks forward to implementing this vision.

The first step to the future begins with looking at, and learning from, the past and the present. Some future events can be controlled in whole or in part; others will be independent of Agency actions. Some future events are already on the horizon, and NASA is planning to meet them; others will be a complete surprise. To persevere, NASA needs a flexible organization and hardy plans that consider a wide range of future possibilities.

Adept planning and program management takes all of these considerations into account. This entails identifying trends and assessing their potential effects, preparing for likely opportunities, and keeping the organization agile and perceptive enough to meet the future in whatever form it takes. NASA is doing all of this. But, planning and program management also means assessing and preparing for risks, and this aspect of management has special meaning at NASA.

*The loss of Space Shuttles Challenger and Columbia and their crews are a stark reminder of the inherent risks of space flight and the severity of the challenges posed by space exploration. In preparation for future human exploration, we must advance our ability to live and work safely in space and, at the same time, develop the technologies to extend humanity's reach to the Moon, Mars, and beyond... We cannot today identify all that we will gain from space exploration; we are confident, nonetheless, that the eventual return will be great.*

President George W. Bush  
January 2004

Safety is NASA's number one priority. Since the beginning of the space program, NASA has lost 24 astronauts. These men and women believed in their mission, understood the risks, and accepted the dangers. They did not turn away. In tribute to them, NASA will forge ahead while continuing to find ways to make space exploration as safe as humanly possible.

To achieve NASA's new vision, the Agency must develop and test a new spacecraft: the Crew Exploration Vehicle. This vehicle will be the first spacecraft of its kind since the Apollo Command Module. It must be able to ferry astronauts and scientists to and from the International Space Station after the current fleet of Shuttles is retired in 2010. But, the main function of this spacecraft will be to carry astronauts beyond Earth's orbit to other worlds.

Along the way to the Moon, Mars, and beyond, NASA and the Agency's partners undoubtedly will facilitate innumerable technological breakthroughs and enable countless technology transfer opportunities that will benefit all humankind. No one can predict when each will come or what its impact will be, but most assuredly, the Nation's investments and the Agency's efforts will be repaid many times over.

NASA also is preparing to confront the organizational and management challenges that lie ahead. The Administration's new vision and direction for the U.S. space exploration program likely will require significant changes in NASA's infrastructure and resources (e.g., budget and staffing levels, and facilities). Integrating budget and performance will be critical as will developing valid performance standards and measures. And, the initiatives of the President's Management

Agenda must be addressed with renewed intensity. NASA accepts and is committed to effectively resolving these management challenges.

As NASA pushes the limits of human imagination and redefines what is possible, as Americans rediscover the excitement of a robust space program, and as students are inspired to study math, science, and engineering, NASA's renewed Vision will become a unifying mission for all people. America will invite other nations to join in this journey into the future, forging new partnerships and alliances that cross all boundaries.

*Mankind is drawn to the heavens for the same reason we were once drawn into unknown lands....We choose to explore space because doing so improves our lives, and lifts our national spirit.*



# The President's Management Agenda

## 2003 Progress and Achievements

In FY 2003, NASA continued to make progress in implementing the five initiatives of the President's Management Agenda (PMA) (see Table 3). The PMA is a multi-year Federal government-wide effort to improve management practices in the following areas:

- Strategic Management of Human Capital;
- Improving Financial Performance;
- Expanded Electronic Government;
- Competitive Sourcing; and
- Budget & Performance Integration.

Each year, the Office of Management and Budget (OMB) rates each Federal agency according to the progress the agency has made in achieving the PMA goals. "Green" indicates success, "Yellow" indicates mixed results, and "Red" indicates unsatisfactory results. Like most Federal agencies, when measured against the PMA's long-term goal of "Getting to Green" in all five initiatives, NASA's current PMA status includes "Yellow" and "Red" ratings. However, in FY 2003, NASA earned progress ratings of "Green" in all five areas reflecting the Agency's overall progress in "Getting to Green." A summary of NASA's FY 2003 efforts toward PMA implementation follows.

PMA Initiative	Current Status <i>(as of 9/30/03)</i>	Implementation Progress <i>(as of 9/30/03)</i>
Strategic Management of Human Capital	Yellow	Green
Improving Financial Performance	Red	Green
Expanded Electronic Government	Red	Green
Competitive Sourcing	Red	Green
Budget and Performance Integration	Yellow	Green

Table 3: NASA's PMA implementation status.

## **STRATEGIC MANAGEMENT OF HUMAN CAPITAL**

NASA's most valuable asset in accomplishing its Mission efficiently, effectively, and safely is the excellence of its workforce. This year, NASA continued to work toward keeping this asset robust through the following activities:

- NASA introduced the use of surveys and enhanced data systems for measuring progress on human capital management initiatives Agency-wide. NASA also charged all senior leaders with integrating human capital management considerations in all decision-making activities.
- NASA deployed an Agency-wide Competency Management System as part of a larger workforce planning and analysis tool suite that will enable the Agency to identify current gaps in critical competencies, as well as competencies determined to be "at risk" for the future. The results will help NASA target recruitment and training efforts to meet these needs.
- NASA established a strategic partnership among three key NASA Offices (Human Resources, Education, and Equal Opportunity Programs) to integrate education and recruitment programs with current and future program initiatives. This will also help NASA to maintain a pipeline of talent and improve diversity in the talent pool.
- NASA also established a corporate recruiting strategy that addresses the integrated priorities of the Agency, eliminating the Center-by-Center competition for the brightest candidates.

## **COMPETITIVE SOURCING**

Since its inception, NASA has partnered with the private and academic sectors to achieve our Agency goals. In FY 2003, NASA continued to use the competitive marketplace as a tool for making the most of taxpayer dollars:

- NASA applied competitive sourcing requirements to the environment of scientific research by institutionalizing the requirement that NASA scientists submit proposals and compete against their counterparts in industry and academia. The proposals are evaluated with substantial input from the external scientific community, and the best-in-class winners enable NASA to maintain world-class performance.

- NASA initiated preliminary planning for two public-private competitions, including the NASA Shared Services Center (NSSC), which will consolidate into a single location a significant number of functional activities/services that currently are performed at multiple locations across the country. The NSSC will result in business and specialty services that are more consistent, higher quality, more timely, and more efficient.
- NASA applied the Competitive Sourcing concept to the operation of the Jet Propulsion Laboratory (JPL) of the California Institute of Technology (Caltech). In 2003, NASA renegotiated the JPL contract with Caltech, and the new contract incorporates several competitive features, including the requirements that JPL compete for the majority of its work through NASA's competitive Broad Agency Announcement (BAA) process. Caltech also must submit a competitive sourcing plan for JPL that will be updated annually.

## **EXPANDED ELECTRONIC GOVERNMENT**

In FY 2003, NASA used electronic government to enhance electronic services to citizens, business partners, and employees, and to improve the efficiency and effectiveness of the Agency's information technology (IT) activities.

- NASA re-engineered its Web portal to better communicate the Agency's Vision, Mission, Goals, and accomplishments, and to provide visitors with easily accessible and relevant information. Web portal redesign efforts focused on implementing an intuitive graphic design, improving content management, creating an information classification system, and deploying a more sophisticated search engine. Between February and July 2003 (following the *Columbia* accident), the portal received over 1.4 billion hits. In June 2003, NASA's Web portal received a Webby Award, recognizing it as one of the world's premier Web sites.
- NASA continued to integrate our IT planning, implementation, and management activities to ensure alignment of strategic IT focus areas with the Agency's Mission and Goals as well as with Federal guidelines. We produced an Information Resources Management Strategic Plan and Enterprise Architecture document, providing both NASA's IT vision and a detailed roadmap for moving from the current state to our desired future state. We improved our process for the selection, control, and evaluation of NASA's IT investments to maximize efficient spending,

reduce potential redundancy, and best meet the needs of the Agency.

- NASA strengthened the Agency's IT security program through the implementation of new policies and procedures designed to improve our overall security posture. We demonstrated progress in the rapid identification and correction of known system vulnerabilities, and improved the timeliness of the Agency's response to actions required under the Federal Information Security Management Act (FISMA). Our ultimate goal is to ensure that IT systems have been appropriately secured according to Federal IT security requirements.
- NASA provided significant contributions to a number of Federal E-government initiatives, and we continue to participate actively in these interagency activities. We provided staff support for several Federal activities, including technical expertise for the E-Authentication and Geospatial One Stop initiatives and shared Agency experiences in support of the Recruitment One Stop and E-Travel initiatives. During this Fiscal Year, NASA also prepared for implementation of E-Payroll, which will replace the current NASA-specific payroll systems.

## IMPROVING FINANCIAL PERFORMANCE

In FY 2003, NASA improved its financial performance:

- NASA eliminated 140 disparate financial systems and successfully implemented our CF module to become the first and only Federal agency to implement a commercially-provided Enterprise Resources Planning (ERP) system across the entire organization. There are more than 7,000 users across NASA transacting with the new CF application. By implementing the CF module, we standardized our requirements, processes, and data and achieved major improvements in the timeliness, usefulness, reliability of, and access to financial management data. The Internal Revenue Service and other Federal agencies are benchmarking NASA's IFM program for their ERP implementation planning.
- NASA re-engineered the audit process in tandem with the deployment of the IFM program to improve overall internal controls related to property, plant, equipment, and the financial audit process. In 2003, we improved reporting on contractor-held property by establishing a Contractor Working Group and requiring quarterly reporting of detailed data, including Work in Process and Materials.

We also strengthened internal controls over contractor-held property by: increasing reviews and validation of contractors' data; conducting formal and informal training and seminars for contractors; conducting financial management requirements training for NASA property accountants; and formalizing consistent processes for determining amounts of assets in space.

## BUDGET AND PERFORMANCE INTEGRATION

In FY 2003, NASA made advances in integrating the Agency's budget with its performance plan:

- We successfully integrated the Agency's budget with its performance measures. We can now make clear what performance goals we will achieve with requested budget resources and identify the full cost of our programs. Our budget request and performance plan is now a single, user-friendly document.
- We released NASA's *2003 Strategic Plan* eight months early to provide guidance on our new budget structure and the budget and performance integration initiative. We issued the *2003 Strategic Plan* with the FY 2004 President's budget and the FY 2004 performance plan at the beginning of February 2003. NASA revised and released the *FY 2004 Performance Plan* in September 2003 to make performance measures more quantifiable and verifiable.
- NASA implemented a new Theme-based budget structure that allocates all of NASA's activities—and the budget—among 18 program and budget Themes. Themes are portfolios of related program efforts managed collectively to meet performance commitments. Each Theme is responsible for meeting specific Agency strategic objectives. The new Theme structure also simplifies the budget, making the link between budget and performance a reality.
- NASA released a true full cost budget for FY 2004. We are making decisions and developing the FY 2005 budget in full cost.

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# Reliability and Completeness of Financial and Performance Data

As defined by its Mission statement, NASA is an organization dedicated to understanding and protecting our home planet, exploring the universe, searching for life beyond our planet, and inspiring the next generation of explorers.

Most of NASA's activities undertaken to achieve this Mission involve cutting-edge scientific research taking place over several years. The results are often unpredictable, and schedules are subject to constant change. These challenges create the daunting task of developing an effective and appropriate way to measure and report NASA's efforts and achievements to the American people. We accept this responsibility with the same vigor as we conduct our scientific research.

Many NASA employees worked to make this report interesting, readable, and easily understandable, while simultaneously establishing a clear link between measurable results and NASA's ambitious long-term goals.

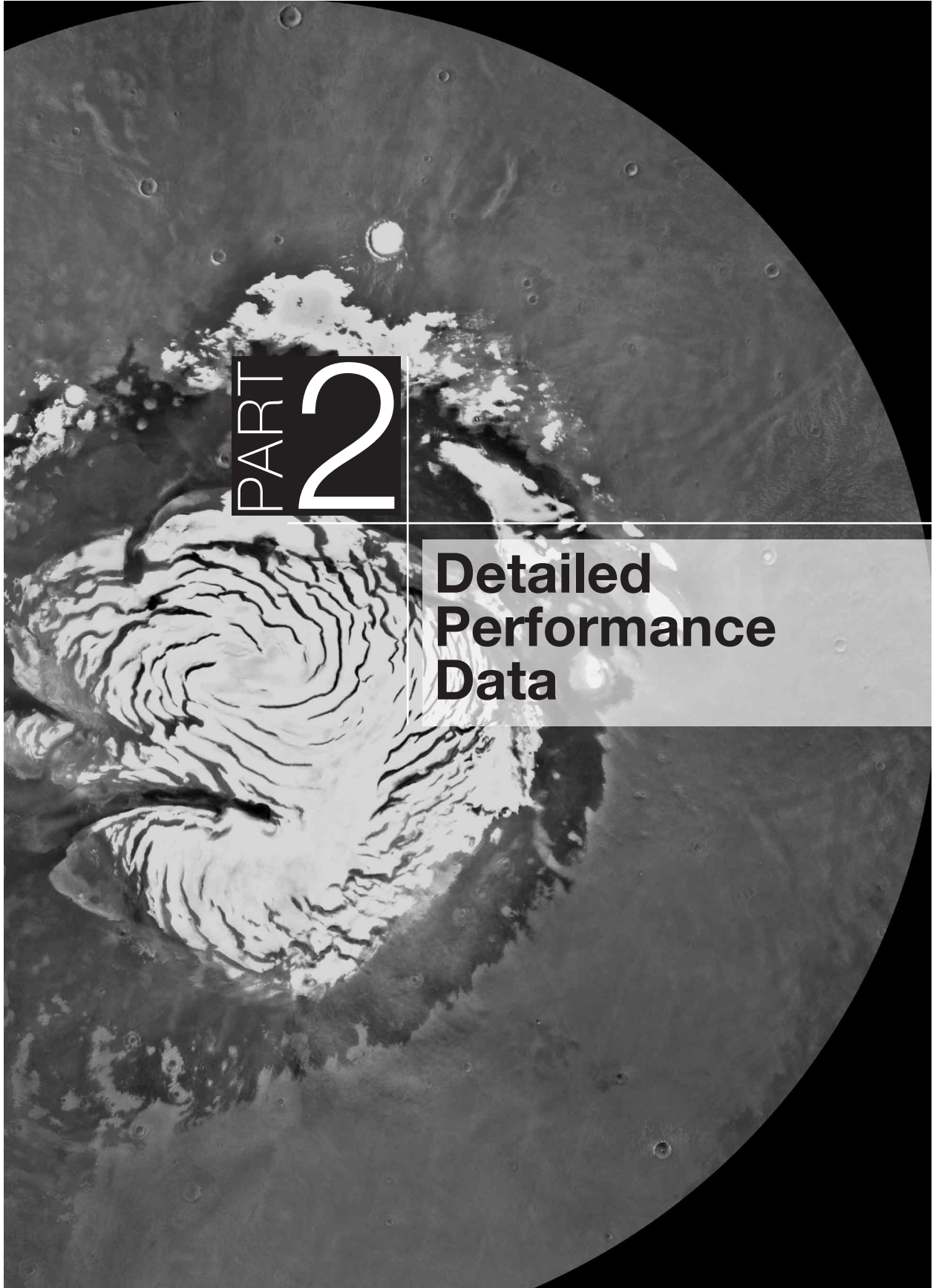
Finally, NASA provided all pertinent data, ensured its reliability to the best of our abilities, and identified the few existing deficiencies. However, largely due to the financial system conversion issues, our auditors issued a disclaimer of an audit opinion on the FY 2003 financial statements. Working with the Deputy Administrator, the Chief Financial Officer and the Program Executive Officer for Integrated Financial Management, we plan to take all of the necessary corrective actions to significantly improve our FY 2004 financial statement audit results.



Sean O'Keefe  
NASA Administrator







**PART  
2**

**Detailed  
Performance  
Data**



# FY 2003 Detailed Performance Data

## Introduction to NASA's Detailed Performance Data

NASA uses annual performance goals (APGs) as a means to measure annual performance. In FY 2003, NASA achieved 96 of its 116 APGs. Each of the APGs resides within one or more of NASA's ten Agency Goals. Across seven of the Agency Goals, NASA achieved 80 percent or greater of the APGs assigned to that Goal (see Figure 38).

"Part 1: Management Discussion and Analysis" of this report, presents NASA's Performance Achievement Highlights. This section, "Part 2: Detailed Performance Data," presents NASA's detailed APG performance data organized by the Agency's ten Goals.

Every APG presented in NASA's *FY 2003 Performance Plan Remapped* (available at <http://ifmp.nasa.gov/codeb/docs/FY03PerformancePlanRemapped.pdf>) is summarized in this section in easy-to-read tables. Each summary includes:

- The progress made in, and performance rating assigned to, each APG, (see Table 4 for performance ratings) including any related performance indicators;
- The actions required to achieve the APG (if it was not achieved);

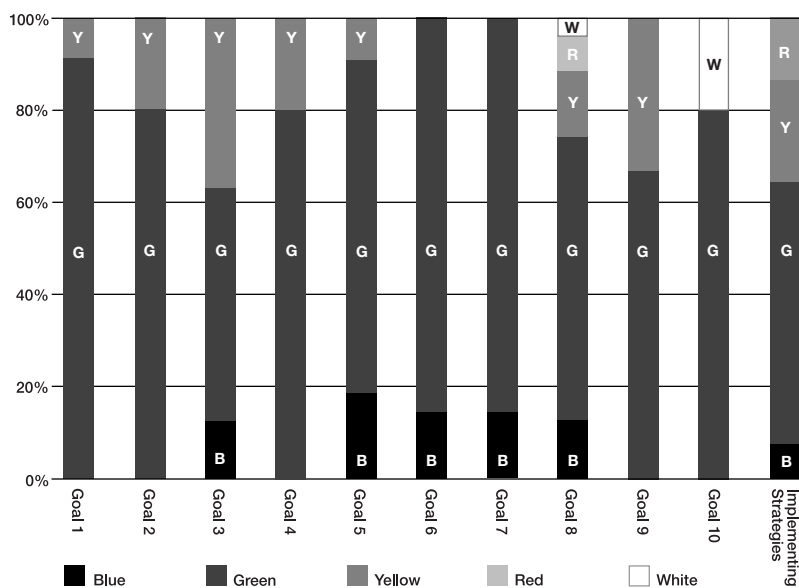


Figure 38: Summary of NASA's Performance by Agency Goal.

- Sources to go to for more information on the APG or related activities; and
- The NASA Enterprise and/or Theme responsible for the APG (see Figure 39 for the list of Enterprises and Themes).

Performance Rating	Performance Rating Parameters
<b>Blue</b>	Significantly exceeded annual performance goal.
<b>Green</b>	Achieved annual performance goal.
<b>Yellow</b>	Failed to achieve annual performance goal, progress was significant, and achievement is anticipated within the next fiscal year.
<b>Red</b>	Failed to achieve annual performance goal, completion within the next fiscal year is not anticipated, and target may be infeasible or unachievable.
<b>White</b>	Annual performance goal postponed or cancelled by management directive.

**Table 4: NASA's Performance Ratings.**

Some APGs include performance indicators that provide specific criteria to help NASA verify and validate performance on certain APGs. Performance indicators for APGs can be

found in the original *FY 2003 Performance Plan*, which can be accessed at [http://ifmp.nasa.gov/codeb/budget2003/27-Performance\\_Plan.pdf](http://ifmp.nasa.gov/codeb/budget2003/27-Performance_Plan.pdf). In some cases, the successful achievement of an APG is determined by meeting a certain number of quantifiable sub-goals known as performance indicators. Where possible, this report has identified these performance indicators with a numbered bullet (①), and aligned the language contained within the indicator with the language in the Accomplishments section of each APG summary.

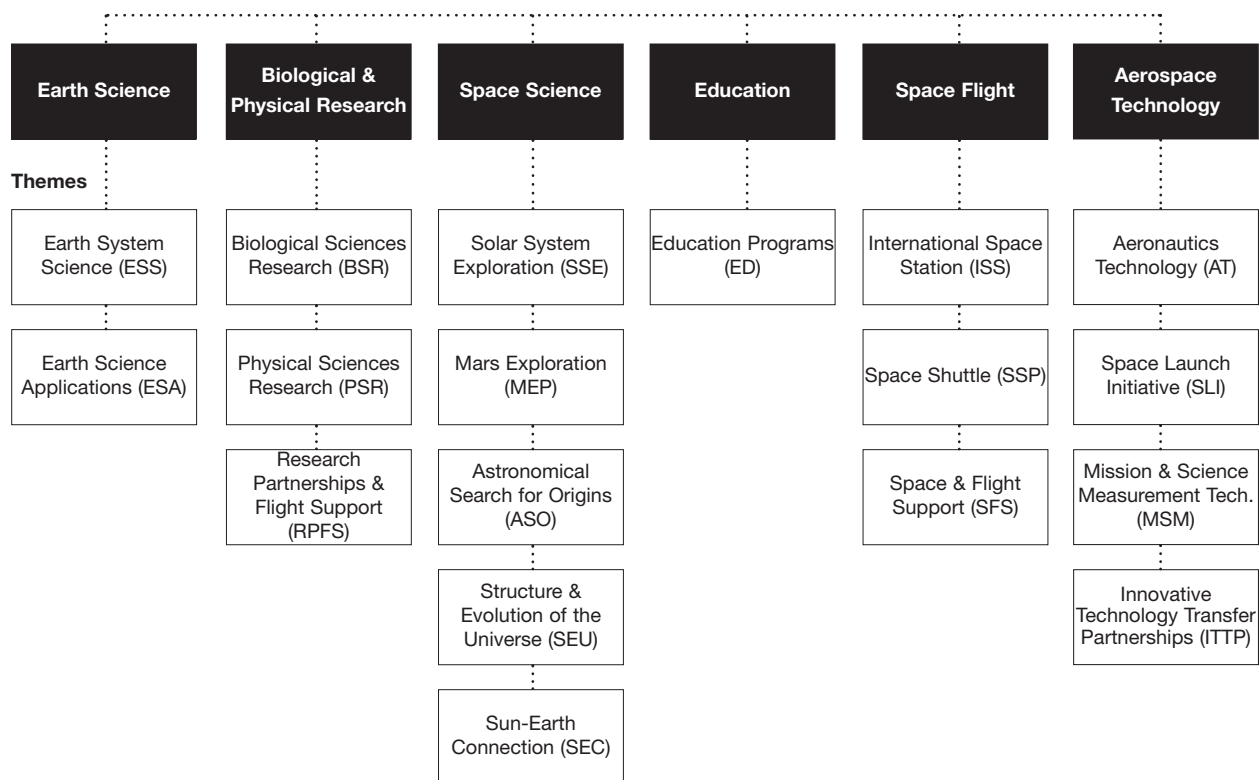
Performance ratings for fundamental management support activities, called Implementing Strategies, are also included in this section.

NASA's performance on all APGs for the past four fiscal years can be found in Appendix I of this report.

## Actions Planned to Achieve Unmet Goals

Despite a year of many successes, the *Columbia* accident adversely affected our ability to achieve some of our APGs. The affected APGs note whether they were affected by

### Enterprises



**Figure 39: NASA's Enterprises and Themes as of September 30, 2003.**

*Columbia* as well as any corrective actions being undertaken to achieve the goal in the future. With the help of the *Columbia* Accident Investigation Board's recommendations, we will recover from this tragedy, make the necessary changes to prevent future accidents, and return to flight.

## **Data Verification and Validation**

NASA is committed to ensuring that its performance data is reliable and verifiable. Data credibility is crucial to effective management and accountability. Therefore, we evaluate our performance at all levels, from Agency-wide to individual programs and projects. Each level is responsible for monitoring and reporting results. Whenever performance fails to meet plan, we identify strategies for reengineering and continual improvement. In cases where performance poses a major concern, we conduct special evaluations and institute targeted mitigation programs. We then carefully examine the results to guide planning and budget decisions.

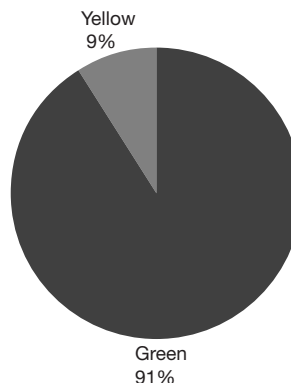
NASA also uses external reviews to evaluate our performance. These reviews include extensive peer-review processes in which panels of outside scientific experts ensure that science research proposals are selected strictly on the merits of the research plan and expected results. We also rely on a broad, diverse system of advisory committees established under the Federal Advisory Committee Act, including the NASA Advisory Council and the Aerospace Safety Advisory Panel and their subcommittees. Hundreds of science, engineering, and business experts on these committees provide external input on management, programs, strategic plans, and performance. Advisory committees explicitly review and evaluate performance data, integrating quantitative output measures and taking into account considerations of safety, quality, results, and risk. NASA also relies on periodic evaluations from specially convened panels of experts and from external organizations, such as the National Academy of Sciences and the General Accounting Office. An independent accounting firm, PricewaterhouseCoopers, audited the financial statements; their findings appear in "Part 3: Financials."



## Mission I: To Understand and Protect our Home Planet

**Goal 1:** Understand the Earth system and apply Earth system science to improve prediction of climate, weather, and natural hazards.

*In FY 2003, NASA achieved 32 of 35 annual performance goals (APGs) under Goal 1. Significant strides in the other three APGs resulted in a “yellow” rating.*



**Objective 1.1 Understand how the Earth is changing, better predict change and understand the consequences for life on Earth.**

**APG 3Y1:** Increase understanding of global precipitation, evaporation and how the cycling of water through the Earth system is changing.

**Rating: Green**

**Accomplishments**

NASA achieved this APG by using precipitation data sets to create long-term and/or global rainfall data sets, and inspecting these for possible trends and evidence of impacts of global change. Significant progress was made in assessing the impact of urban areas on their local precipitation patterns. Global data from polar and geostationary satellite observations allowed the creation of new and/or improved data sets on precipitation, atmospheric moisture, and evaporation.

**Source Information**

- Global precipitation data set at Goddard Space Flight Center (GSFC).
- Study by Schlosser et. al., of GSFC, showing the errors in the global water cycle budgets by comparing two sources of both precipitation and evaporation. (The difference between models and observations helps estimate errors in assessment of the water cycle budget.)

**Responsible Enterprise(s),**

**Theme(s)** Earth Science Enterprise, ESS

**APG 3Y2:** Increase understanding of global ocean circulation and how it varies on interannual, decadal, and longer time scales.

**Rating: Green**

**Accomplishments**

- NASA achieved this APG.
- NASA updated the record of trends in sea ice duration, concentration, and extent and made considerable progress in understanding changes in sea ice cover in the Arctic and Antarctic. For the first time, the perennial ice cover trends were rigorously examined and displayed dramatic changes.
  - NASA initiated production of sub-monthly analysis from a data-assimilating global ocean model, using NASA and other agency satellite and in situ observations to evaluate ocean circulation changes such as those associated with El Niño. This work was done via the Global Ocean Data Assimilation Experiment. Time series were generated from Estimating the Circulation and Climate of the Ocean simulations that can be used to trace the development of El Niño in the Pacific.

**Source Information**

- “The origin, pathway, and destination of El Niño water estimated by a simulated passive tracer and its adjoint,” *Journal of Physical Oceanography* (submitted). Fukumori, I., T. Lee, B. Cheng, and D. Menemenlis, 2002.

**Responsible Enterprise(s),**

**Theme(s)** Earth Science Enterprise, ESS

**APG 3Y3:** Increase understanding of global ecosystems change. **Rating: Green**

**Accomplishments** NASA achieved this APG through continued analysis of data from different sensors merged to provide broader spatial and longer temporal coverage. Analysis of 18 years of vegetation indices derived from satellite observations showed increases in primary productivity on land, with the largest changes in the tropics. Data from field campaigns enabled better models of the processes underlying these observed changes, improving the means for interpreting observations and making ecosystem predictions.

**Source Information**

- “Climate Driven Increases in Global Terrestrial Net Primary Productivity from 1982–1999,” *Science* 300:1560–1563. Nemani, R. R., C. D. Keeling, H. Hashimoto, W. M. Jolly, S. C. Piper, C. J. Tucker, R. B. Myneni, and S. W. Running, 2003.
- *Journal of Geophysical Research* (Volume 107). Special issue documents early results from a field campaign in the Amazon.

**Responsible Enterprise(s),  
Theme(s)** Earth Science Enterprise, ESS

**APG 3Y4:** Increase understanding of stratospheric ozone changes, as the abundance of ozone-destroying chemicals decreases and new substitutes increases by meeting 2 of 2 performance indicators. **Rating: Yellow**

**Accomplishments** NASA failed to achieve this APG, although progress was significant.

- 1 NASA made progress in providing a trends quality data set for total ozone despite the launch failure of the QuikTOMS satellite instrument in 2001, which impacted our ability to achieve this goal.
- 2 NASA made progress in characterizing the inter-annual variability and possible long-term evolution of stratospheric aerosols and of the vertical profiles of methane, water vapor, and temperature to assist in the interpretation of observed ozone changes and chemistry-climate interactions. Instruments on the Aura satellite will continue the ozone profile trends record above 20 kilometers and provide a greatly improved capability to establish a trends record at lower altitudes. However, these new measurements will not be sufficiently mature to address ozone recovery for several years, and it will take many years to develop an ozone profile record below 20 kilometers adequate for trends purposes.

**Corrective Actions**

- 1 A merged data record from the Total Ozone Mapping Spectrometer (TOMS) series of instruments and Solar Backscatter Ultraviolet (SBUV/2) instruments is being updated using data from the most recent SBUV/2 instruments.
- 2 Following the launch of the Aura satellite in early 2004, the Ozone Monitoring Instrument (OMI) instrument is expected to be the primary data source for continuing the column ozone record.

**Source Information**

- Total Ozone satellite data: TOMS, SBUV, Dobson and Brewers.
- A merged record containing 23 years of data (1979–2001) is available at [http://code916.gsfc.nasa.gov/Data\\_services/merged/](http://code916.gsfc.nasa.gov/Data_services/merged/).
- Upper Stratospheric Profile satellite data: SAGE, HALOE, SBUV, UMKEHR, and NDSC LIDARS. Available at <http://www.ndsc.ws>.
- Lower Stratosphere satellite data: ozonesondes, NDSC LIDARS, and SAGE.

**Responsible Enterprise(s),  
Theme(s)** Earth Science Enterprise, ESS

**APG 3Y5:** Increase understanding of change occurring in the mass of the Earth’s ice cover by meeting at least 3 of 4 performance indicators. **Rating: Green**

**Accomplishments** NASA achieved this APG by meeting all four performance indicators.

- 1 NASA converted remotely sensed observations of Greenland ice sheet surface melting to estimates of ice mass loss to quantify how much ice is lost to melting and its variability from year to year. NASA also achieved quantitative melt estimates through numerical

climate models developed with a combination of in situ and remote sensing data. They show an increasing trend in amount of melt on the ice sheets, in recent years, which is consistent with the passive microwave satellite observations.

② The RADARSAT Antarctic Mapping Mission produced fine-beam (15-meter) data for certain outlet glaciers, providing unprecedented detail in the glaciological features in these critical regions. “Mini-mosaics” were developed for the area around the Thwaites and Pine Island glaciers, which is the primary location of instability in West Antarctica (most likely to result in rapid sea level rise from ice sheet discharge).

③ NASA made substantial progress in understanding mass changes of the Greenland and Antarctic ice sheets by:

- a. Compiling 20 years of accumulation and melt rates from satellite and field measurements in Greenland;
- b. Launching the Ice Cloud and Land Elevation Satellite (ICESat) (initial data show unprecedented ability to retrieve high-accuracy elevation and elevation-change information on ice sheet and, potentially, sea ice); and
- c. Improving NASA’s ability to separate gravity and elevation change signals when determining the growth and shrinkage of Earth’s ice sheets.

④ NASA performed an initial assessment of the extent to which sea ice thickness can be determined using ICESat. Data of unprecedented accuracy and density was obtained over the ice sheets, providing the initial baseline measurements of elevation. Initial analysis of the data over sea ice indicate that ice surface elevations can likely be retrieved over sea ice and thickness estimates should be possible.

**Source Information**

- “Spatial and temporal variability in Greenland ice sheet surface mass balance parameters in the Polar MM5 mesoscale atmospheric model,” Box J. E., D. H. Bromwich, L-S. Bai, in preparation for submission to *Journal of Geophysical Research*.
- The mini-mosaics are discussed in the principal investigator’s most recent progress report (submitted in May 2003).
- Reports from the ICESat science team, and data archived on the ICESat Science Investigator-led Processing System (I-SIPS).

**Responsible Enterprise(s),**

**Theme(s)** Earth Science Enterprise, ESS

**APG 3Y6:** *Increase understanding of the motions of the Earth, the Earth’s interior, and what information can be inferred about the Earth’s internal processes.*

**Rating: Green**

**Accomplishments**

NASA achieved this APG.

- NASA shared observational technology with other Federal, state, local and educational organizations to understand deep Earth forces and the impact on the deformation of Earth’s surface. The program focused on upgrading these observational systems in FY 2003 and producing new global gravity and geomagnetic reference fields that are the most accurate global measurements available (the Gravity Recovery and Climate Experiment [GRACE] Gravity Model 01 and the Comprehensive Model-4 [CM4] geomagnetic field model).
- NASA completed fabrication of the SLR2000 prototype tool (a completely automated ranging station); testing and co-location are underway. It will replace the current NASA legacy network to provide a uniform global observing network, and significantly improve the International Terrestrial Network.
- The real-time Global Differential Global Positioning System (GDGPS) network reached a significant milestone for a research system by exceeding planned outcome for its use as a test program to develop an effective GPS (Global Positioning System) monitoring system for the health of the U.S. GPS.

- NASA continued participation in the EarthScope Program, a collaboration of the National Science Foundation (NSF), United States Geological Survey (USGS), and NASA, to develop the USArray, San Andreas Fault Observatory at Depth (SAFOD), and Plate Boundary Observatory (PBO) components.
- NASA collaborated with international colleagues and agencies to improve the capability and accuracy of the global geodetic observing strategy by developing the International Global Geodetic Observing System. The objective of this program is a 1-millimeter-accuracy global terrestrial reference frame to better understand and measure the effect of deformation and sea level change imposed by both tectonic and climatic global forces.

**Source Information**

- Progress reports on GRACE are available at <http://www.csr.utexas.edu/grace/1>.
- “NASA’s Photon-Counting SLR2000 Satellite Laser Ranging System: Progress and Applications.” 2003 AMOS Technical Conference - Air Force Research Laboratory. Degnan, J.J., J. McGarry, T. Zagwowski, H. Donovan, D. Patterson, C. Steggerda, A. Mallama, J. Cheek, 2003. Also available at <http://www.maui.afmc.af.mil/AMOS2003/history.html>.
- Reports on the progress in Southern California Integrated GPS Network (SCIGN) are available at <http://www.SCIGN.org/>.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

**Responsible Enterprise(s),**

**Theme(s)**

Earth Science Enterprise, ESS

**APG 3Y7:** *Increase understanding of trends in atmospheric constituents and solar radiation and the role they play in driving global climate by meeting at least 4 of 5 performance indicators.*

**Rating: Green**

**Accomplishments**

NASA achieved this APG by meeting four of five performance indicators.

- 1 NASA continued and extended the current 25-year record of concentration measurements through continuous ground-based sampling of tropospheric air and demonstrated the diminishing abundances of most halocarbons regulated under the international Montreal Protocol and the increase of replacement chemicals. Comparisons between NASA and National Oceanic and Atmospheric Administration (NOAA) networks reduced uncertainties in the trend results and improved our ability to quantify and monitor the atmosphere’s capacity to cleanse itself of pollutants.
- 2 NASA combined measurement of carbon monoxide and methane in a new model improving future investigations of inter-annual variations in global emissions.
- 3 NASA used comprehensive, multi-instrument, integrated data for studying the sources/sinks and distribution of tropospheric aerosols over land based on data from TOMS, Moderate Resolution Imaging Spectroradiometer (MODIS), and Multi-angle Imaging Spectroradiometer (MISR) instruments to support evaluation of the impact on climate forcing of natural and anthropogenic aerosols in the atmosphere.
- 4 The Active Cavity Radiometer Irradiance Monitor Satellite (ACRIMSAT) completed another year of operation providing accurate measurements of Total Solar Irradiance (TSI). The launch of the Solar Irradiation and Climate Experiment (SORCE) began a new generation of more accurate TSI and Spectral Irradiance Measurements (SIM).

**Source Information**

- “Scientific Assessment of Ozone Depletion: 2002,” World Meteorological Organization, Global Ozone Research & Monitoring Project—Report No. 47. Advanced Global Atmospheric Gases Experiment (AGAGE) Network and NASA-funded University of California Irvine (UCI) flask-sampling network, 2003.

**Responsible Enterprise(s),**

**Theme(s)**

Earth Science Enterprise, ESS

**APG 3Y8:** *Increase understanding about the changes in global land cover and land use and their causes.* **Rating: Green**

**Accomplishments** NASA achieved this APG by compiling and submitting for publication case studies addressing the causes of land cover and land use change. The book, *Land Change Science: Observing, Monitoring, and Understanding Trajectories of Change on the Earth's Surface*, synthesizes and describes lessons learned from case studies worldwide, including initiatives in the Amazon, Central and Southern Africa, Southeast Asia, and Russia organized within the Global Observation of Forest and Land Cover program. State-of-the-art integrated land-change science and its relevance to the human sciences are at the core of this book.

**Source Information** • *Land Change Science: Observing, Monitoring, and Understanding Trajectories of Change on the Earth's Surface*. Kluwer Publishers.

**Responsible Enterprise(s), Theme(s)** Earth Science Enterprise, ESS

**APG 3Y9:** *Increase understanding of the Earth's surface and how it is transformed and how such information can be used to predict future changes.* **Rating: Green**

**Accomplishments** NASA achieved this APG.

- NASA developed new capability for monitoring volcanic deformation and predicting volcanic eruptions and lahar (ash from volcano) flows. Principal among these are the generation of new topographic data sets via the Shuttle Radar Topography Mission and the release this year of 30-meter digital terrain models for the Aleutian and Cascadian volcanic chains, as well as 90-meter models of the South American volcanic chains. In many cases, this provides the first accurate topographic data for the calculation of lahar flows and the recovery of volcanic inflation information from sparse interferometric Synthetic Aperture Radar (SAR) data.
- NASA continued development of an airborne repeat pass Interferometric SAR (InSAR) for high-spatial and temporal measurement of volcanic inflation, an important predictive tool during the final phases of eruption. The repeat pass airborne capability, as well as satellite repeat pass InSAR, is the highest priority with final delivery in 2006. These new topographic data also are valuable for monitoring the world's active volcanoes.
- NASA conducted basic research to improve volcanic eruption forecasting through announcements of opportunity and participation in the EarthScope program.
- NASA continued work with the Russian Academy of Sciences, the Japanese Space Agency, and the USGS to develop the Asia Pacific Arc Natural Laboratory to focus research and resources upon the Aleutian, Kamchatkan, and Kurile Volcanic arcs—a region of highly explosive volcanoes that underlies major air traffic routes and the source of devastating volcanic plumes and tsunamis.
- NASA supported the development and publication of a successful predictive model for California earthquakes based on data mining and fault interactions. The model, generated by Dr. John Rundle and colleagues at the University of California at Davis, identifies well-defined hot spots that are likely to experience moderate to large earthquakes within the decade. Thus far, all California earthquakes of magnitude five or larger have occurred within the specified zones; the probability of this happening by pure chance is one in 100,000.
- NASA used space geodetic and remote sensing technologies to reveal precursor and silent stress transfers along faults that had not been previously observed. The research community is optimistic that these new technologies will provide breakthroughs in earthquake prediction.

**Source Information** • A summary of Shuttle Radar Topography Mission (SRTM) data is available at <http://www.jpl.nasa.gov/srtm/>.  
• Information on the EarthScope program is available at <http://www.EarthScope.org>.



- USGS Earth Resources Observation Systems (EROS) data center  
<http://edc.usgs.gov/srtm/data/obtainingdata.html>.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

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**Responsible Enterprise(s),**
**Theme(s)** Earth Science Enterprise, ESS
 

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**APG 3Y10:** *Increase understanding of the effects of clouds and surface hydrologic processes on climate change.*
**Rating: Green**
**Accomplishments**

NASA achieved this APG by presenting the first results of the Cirrus Regional Study of Tropical Anvils and Cirrus Layers – Florida Area Cirrus Experiment (CRYSTAL-FACE) investigation. The mission provided new data for understanding clouds and aerosols from satellite and in situ observations. Results showed new ways to determine cloud formation processes and new methods to evaluate clouds from satellite platforms through comparison with Terra, Aqua, and Tropical Rainfall Measuring Mission (TRMM) satellite instruments.

**Source Information**

- The CRYSTAL-FACE dataset is available at <http://cloud1.arc.nasa.gov/crystalface/>.

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**Responsible Enterprise(s),**
**Theme(s)** Earth Science Enterprise, ESS
 

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**APG 3Y11:** *Increase understanding of how ecosystems respond to and affect global environmental change and affect the global carbon cycle.*
**Rating: Green**
**Accomplishments**

- NASA achieved this APG.
- NASA used satellite data and data from field campaigns to examine the response of ecosystems to various environmental and climatic forcings, and enable global carbon cycling studies.
  - Satellite and in situ chlorophyll records show that global ocean primary production has declined more than six percent since the early 1980s, with almost 70 percent of this decline occurring in the high latitudes. The North Atlantic and North Pacific experienced major increases in sea surface temperature of 0.7 and 0.4 °C respectively over the time period of the study.
  - NASA began validation activities for Earth Observing System (EOS) Aqua MODIS data and will soon make the data available for research pursuits. NASA researchers can use the data to identify areas of elevated phytoplankton biomass and productivity, as well as certain functional groups (e.g., dinoflagellates, diatoms, coccolithophorids).

**Source Information**

- NASA Interdisciplinary Science solicitation (NRA-03-OES-03) results are available at [http://research.hq.nasa.gov/code\\_y/code\\_y.cfm](http://research.hq.nasa.gov/code_y/code_y.cfm).
- EOS Aqua MODIS validation activities are available at: <http://www.mcst.ssai.biz/mcstweb/L1B/product.html>.
- “Ocean Primary Production and Climate: Global Decadal Changes.” *Geophysical Research Letters* 30(15):1809, Gregg, Watson W, Margarita E. Conkright, Paul Ginoux, John E. O’Reilly, and Nancy W. Casey, 2003.

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**Responsible Enterprise(s),**
**Theme(s)** Earth Science Enterprise, ESS
 

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**APG 3Y12:** *Increase understanding of how climate variations induce changes in the global ocean circulation by meeting at least 2 of 3 performance indicators.*
**Rating: Green**
**Accomplishments**

- NASA achieved this APG by meeting two of three performance indicators.
- ① NASA used diagnostic analysis of seasonal and interannual variability in ocean winds to evaluate improvements in climate and marine weather forecasting. High-resolution scatterometer measurements from the Quick Scatterometer (QuikSCAT) and SeaWinds

instruments on the Advanced Earth Observing Satellite (ADEOS-2) were used to map accurate high-resolution representations of typhoons, hurricanes and unique wind events such as the Santa Ana Winds in California. QuikSCAT winds are now being incorporated into weather forecast systems and hurricane warning systems. Additional applications to mapping sea ice, ice motion, rain and rain corrections are also being explored.

② NASA used sea surface topography and in-situ upper-ocean temperature measurement models to elucidate the mechanisms of temperature oscillations and their impact on seasonal and decadal climate variations. NASA also exploited the continuing record of satellite altimetry to map changes in the circulation of all of the world's oceans. These altimetric observations have been used to characterize El Niño events, demonstrate Rossby wave propagation, and show seasonal changes in major current systems. The data is being assimilated into a variety of models that are being used to perform increasingly high-resolution (1/10 degree) simulations of ocean circulation both in the open ocean and in the coastal regions.

**Source Information**

- “High Resolution Measurements with a Spaceborne Pencil-Beam Scatterometer Using Combined Range/Doppler Discrimination Techniques,” *IEEE Transactions on Geoscience and Remote Sensing*. M.W. Spencer, W-Y Tsai, and D.G. Long, 2002.
- “Evaluation of a Compound Probability Model with Tower-Mounted Scatterometer Data,” *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 40, No.1. B.E. Barrowes and D.G. Long, 2002.
- Ocean Surface Vector Winds Science Team at <http://winds.jpl.nasa.gov>.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

**Responsible Enterprise(s),**

**Theme(s)**

Earth Science Enterprise, ESS

**APG 3Y13:** *Increase understanding of stratospheric trace constituents and how they respond to change in climate and atmospheric composition.*

**Rating: Green**

**Accomplishments**

NASA achieved this APG.

- NASA utilized combined data sets from ground-based, sub-orbital, and space-based measurements to assess the possible impact of the increased abundances of greenhouse gases on the future evolution of Northern Hemisphere high-latitude ozone concentrations. Also, NASA jointly conducted the second Stratospheric Aerosol and Gas Experiment (SAGE III) and Stratospheric Ozone Loss and Validation Experiment (SOLVE II) with the European Communities-sponsored Validation of International Satellites and Study of Ozone Loss (VINTERSOL) campaign and the European Polar Stratospheric Cloud and Lee Wave Experiment (EUPLEX). These joint international activities were designed to acquire correlative data needed to validate satellite measurements of the polar stratosphere and to investigate polar ozone loss, polar stratospheric clouds, processes that lead to ozone loss, and the dynamics of the polar stratosphere.
- NASA quantified the relationship between wintertime tropospheric wave energy and late winter temperatures in the Arctic lower stratosphere to analyze the effects of changing tropospheric weather patterns on Arctic ozone chemistry. The 2002 Antarctic ozone hole provided a spectacular example of how late wintertime tropospheric wave energy can impact polar ozone levels. The Southern Hemisphere stratospheric winter of 2002 was the most unusual winter yet observed in the Southern Hemisphere climate record. A series of strong tropospheric wave events occurred over the course of the winter that moved upward from the troposphere into the stratosphere. The waves warmed temperatures near the edge of the Antarctic polar vortex, causing higher-than-normal temperatures over the entire course of the winter, and they also weakened the polar night jet, and displaced it

more poleward than has been observed in previous winters. The wave events tended to occur irregularly over the course of the winter, and reconditioned the polar night jet for the extremely large wave event of September 22, 2002. This large wave event resulted in the first-ever observed major stratospheric warming in the Southern Hemisphere, which split the Antarctic ozone hole. The combined effect of the wave events of the 2002 winter resulted in the smallest ozone hole observed since 1988.

<b>Source Information</b>	<ul style="list-style-type: none"> <li>• TOMS data is available at <a href="http://toms.gsfc.nasa.gov/">http://toms.gsfc.nasa.gov/</a>.</li> <li>• Global Modeling and Assimilation Office data is available at <a href="http://gmao.gsfc.nasa.gov/">http://gmao.gsfc.nasa.gov/</a>.</li> <li>• Halogen Occultation Experiment data is available at <a href="http://haloedata.larc.nasa.gov/home.html">http://haloedata.larc.nasa.gov/home.html</a>.</li> <li>• Additional sources for this APG are available at <a href="http://www.ifmp.nasa.gov/codeb/library/reports.htm">http://www.ifmp.nasa.gov/codeb/library/reports.htm</a>.</li> </ul>
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<b>Responsible Enterprise(s), Theme(s)</b>	Earth Science Enterprise, ESS
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**APG 3Y14:** *Increase understanding of global sea level and how it is affected by climate change.* **Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG.</p> <ul style="list-style-type: none"> <li>■ NASA calculated and compared discharge fluxes of nearly 20 outlet glaciers using satellite methods and calculated an overall balance for most drainage basins in Antarctica to provide an assessment of how major outlet glaciers contribute to sea level rise. NASA discovered that melting beneath floating ice shelves contributes substantially to loss of ice in Antarctica. This was the most comprehensive assessment of the ice sheet’s mass balance, to date. The results showed much of West Antarctica losing mass; results in East Antarctica, as a whole, remain unknown.</li> <li>■ NASA initiated development of improved models of outlet glacier flow characteristics to improve prediction capabilities of sea level rise from ice sheet dynamics. NASA selected a proposal to develop a comprehensive model for flow in Greenland’s most active outlet glacier (also the fastest glacier in the world), and made progress in modeling ice stream behavior in Greenland using airborne radar data that “sees” into the ice. The technique identified melting at the bottom of the ice stream—possibly caused by heat from Earth’s interior—as a cause for enhanced sliding.</li> </ul>
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<b>Source Information</b>	<ul style="list-style-type: none"> <li>• Antarctic outlet glacier information published in <i>Science</i> by Rignot and Thomas in August 2002.</li> <li>• Antarctic outlet glacier data is available at <a href="http://www.cecs.cl/eng/research/glaciology/expedition/antartica.html">http://www.cecs.cl/eng/research/glaciology/expedition/antartica.html</a>.</li> <li>• The proposal to model outlet glaciers using NASA data, having only recently been selected, is available only through the principal investigator and the NASA program manager.</li> </ul>
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<b>Responsible Enterprise(s), Theme(s)</b>	Earth Science Enterprise, ESS
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**APG 3Y15:** *Increase understanding of the effects of regional pollution on the global atmosphere, and the effects of global chemical and climate changes on regional air quality by meeting at least 4 of 5 performance indicators.* **Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG by meeting five of five performance indicators:</p> <ul style="list-style-type: none"> <li>① NASA continued to extend the four-year data record of tropical ozone soundings to establish a climatology for improving retrievals of tropospheric ozone concentrations from space-based measurements. The Southern Hemisphere Additional Ozone-sonde (SHADOZ) program continued its fifth year of success of balloon-borne launches and data archiving. SHADOZ will provide a profile climatology of tropical ozone while assisting in the validation and improvement of ozone profile data from satellite remote sensing measurements. The</li> </ul>
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latest data were used to: determine the structure of the zonal wave-one pattern in equatorial ozone initially identified from satellite; benchmark sondes for total ozone accuracy and precision and compare the total ozone measurements with those from Dobson and Brewer instruments; and determine current concentrations and possible ozone trends in this atmospheric region.

② NASA characterized the atmospheric plume from East Asia and assessed its contribution to regional and global atmospheric chemical composition by archiving of the Transport of Chemical Evolution over the Pacific (TRACE-P) airborne mission and associated data sets to improve the assessment of intercontinental transport of pollution. NASA analyzed and used the TRACE-P aircraft data to improve the quantitative understanding of Asian chemical outflow over the Pacific and its relationship to sources.

③ NASA updated the estimate of the tropospheric distributions and possible trends of hydroxyl (OH) radicals and examined the consistency between different model types (i.e., inverse and assimilation) in determining global OH fields using multiple data sets. This will allow assessment of the atmosphere's capacity for self-cleansing. Used the latest Advanced Global Atmospheric Gases Experiment (AGAGE) data for methyl chloroform to update earlier estimates of OH behavior and possible trends in the troposphere. The results suggest a cyclical variation in the global average OH concentration that is dominated by its behavior in the northern hemisphere.

④ A coupled aerosol-chemistry-climate general circulation model now has a full characterization of atmospheric aerosols including carbonaceous species, soil dust, and sea salt. Implemented a microphysical scheme to follow the evolution of aerosol size distributions to examine the indirect radiative forcing effects of aerosols. NASA conducted 2,100 climate simulations to examine the consequences of climate change for chemical transport including convection, stratosphere-troposphere exchange, and interhemispheric exchange.

⑤ NASA improved estimates of the stratospheric contribution to tropospheric ozone through chemical transport models.

**Source Information**

- "Scientific Assessment of Ozone Depletion: 2002," World Meteorological Organization, Global Ozone Research & Monitoring Project - Report No. 47. AGAGE Network and NASA-funded University of California Irvine (UCI) flask-sampling network, 2003.
- The TRACE-P data set is available at <http://www-gte.larc.nasa.gov/>.
- <http://www-as.harvard.edu/chemistry/trop/ids>.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

**Responsible Enterprise(s),**

**Theme(s)** Earth Science Enterprise, ESS

**APG 3Y16:** *Increase understanding of variations in local weather, precipitation, and water resources and how they relate to global climate variation.*

**Rating: Green**

**Accomplishments**

- NASA achieved this APG.
- NASA continued to establish a basis for determining what changes will be induced by climate trends in the frequency, strength, and path of weather systems that produce clouds and rain and replenish fresh water supplies.
  - NASA created and improved a data assimilation algorithm that assimilates satellite observations (TRMM, Aqua, Terra) into weather and climate models.
  - NASA continued GRACE data production that will allow investigation into large-scale rates of recharge/depletion of underground water stores.
  - NASA documented impacts of the urban environment on precipitation formation and patterns.

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**Source Information** • GRACE and Global Modeling and Assimilation Office (GMAO) data sets are available at <http://www.csr.utexas.edu/grace/>.

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**Responsible Enterprise(s),  
Theme(s)** Earth Science Enterprise, ESS

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**APG 3Y17:** *Increase understanding of the consequence of land cover and land use change for the sustainability of ecosystems and economic productivity.* **Rating: Green**

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**Accomplishments** NASA achieved this APG.

- NASA submitted for publication the book, *Land Change Science: Observing, Monitoring, and Understanding Trajectories of Change on the Earth's Surface*. This volume synthesizes and describes lessons learned from case studies worldwide, including initiatives in the Amazon, Central and Southern Africa, Southeast Asia, and Russia organized within the Global Observation of Forest and Land Cover program. State-of-the-art, integrated land-change science and its relevance to the human sciences are at the core of this book.
- NASA held the first conference in a bi-annual series jointly sponsored by NASA's Land Cover Land Use Change program and the International Geosphere Biosphere Programme/International Human Dimensions Program Land Use Cover Change programs on the effects of land use in coastal zones. The meeting developed stronger links between land and ocean remote sensing scientists, ecologists, and social science experts in the transition zone between land and sea.

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**Source Information** • Information on the effects of land use in coastal zones is available at: <http://www.geo.ucl.ac.be/LUCC/lucc.html>

- *Land Change Science: Observing, Monitoring, and Understanding Trajectories of Change on the Earth's Surface*. Kluwer Academic Publishers, in press.

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**Responsible Enterprise(s),  
Theme(s)** Earth Science Enterprise, ESS

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**APG 3Y18:** *Increase understanding of the consequences of climate and sea level changes and increased human activities on coastal regions.* **Rating: Green**

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**Accomplishments** NASA achieved this APG.

- NASA continued research to refine ocean color remote sensing capabilities in the coastal zone, and continued to work on new instrumentation, research, and protocols for in situ and remote sampling of this optically complex environment.
- NASA continued to focus research on coral reefs and the impacts of climate change.
- NASA competed research opportunity this year in interdisciplinary science that furthers NASA's research investments in understanding coastal ocean processes using remotely sensed data. Refinement of atmospheric corrections in ocean color signals is improving and will continue with the EOS research announcement.

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**Source Information** • "Global Decadal Changes," W. Gregg, et al., *Geophysical Research Letters*, Vol. 30, 2003.

- U.S. Coral Reef Task Force's findings and publications on the impacts of climate change on global coral reefs are available at: <http://coralreef.gov/>.
- Principal investigator's research and findings for refinement of EOS atmospheric algorithms and ocean color algorithms for optically complex waters, and for the interdisciplinary science, resulting from NASA ESE research announcement.
- NASA/Italian SeaPRISM Project data. SeaPRISM is a NASA/GSFC and Joint Research Center in Italy collaboration, and is a moored optical instrument exploring improving NASA's satellite-based measurement of ocean color in coastal waters.

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**Responsible Enterprise(s),  
Theme(s)** Earth Science Enterprise, ESS

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**APG 3Y19: Increase understanding of the extent that weather forecast duration and reliability can be improved by new space-based observations, data assimilation, and modeling.**

**Rating: Green**

**Accomplishments**

NASA achieved this APG.

- NASA developed and tested software, installed computers, and delivered raw data to NOAA in real time. Also, a fast radiative transfer model was developed and installed in the operational National Center for Environment Prediction (NCEP) global analysis.
- NASA improved increased light rain rates and reduced excessive rain rates through previous three-dimensional variational assimilation of TRMM, TMI and Special Sensor Microwave Imager rain rates. An Atmospheric Infrared Sounders (AIRS) “targeted-observation” study is underway to determine if significant East Coast forecast “busts” were preventable by the selective use of AIRS data taken over the Pacific Ocean.
- The September 2003 presentation to the National Research Council’s Committee on Environmental Satellite Data Utilization by the Director of the NCEP stressed that operation usage of satellite data has increased from about five million observations a day to around 25 million during FY 2003. Many different sensors are employed and improvements due to each new one are incremental in nature. Progressive increases in the uses of satellite data since the 1970s have now made the Southern Hemisphere atmospheric pressure map accuracies on forecast day five equal to those in the Northern Hemisphere, an accomplishment primarily due to satellite data and also primarily due to the use of passive microwave data.

**Source Information**

- “The Role of Satellite Data in Environmental Modeling: Where America’s Climate and Weather Services Begin,” Dr. Louis Uccellini, Director, National Centers for Environmental Protection (NCEP), presentation given on September 11, 2003.

**Responsible Enterprise(s),**

**Theme(s)**

Earth Science Enterprise, ESS

**APG 3Y20: Increase understanding of the extent that transient climate variations can be understood and predicted.**

**Rating: Green**

**Accomplishments**

NASA achieved this APG by releasing a new version of the fully-coupled atmosphere-ocean-land modeling system designed for the purpose of seasonal-to-interannual climate prediction. The modeling system is producing and contributing model forecasts to national and international organizations responsible for planning and warning. Team members published their findings in peer-reviewed journals using NASA Seasonal-to-Interannual Prediction Project (NSIPP) model data. The core NSIPP continued model development and released model results on a monthly basis.

**Source Information**

- “Stratospheric memory and extended-range weather forecasts,” *Science*. Baldwin, M., D. Stephenson, D. Thompson, T. Dunkerton, A. Charlton, A. O’Neill, 2003.
- “Bred Vectors of the Zebiak-Cane Model and Their Application to ENSO Predictions,” *Journal of Climate*, Vol. 16. Cai, Ming, E. Kalnay and Z. Toth, 2003.
- NSIPP model results are available at <http://nsipp.gsfc.nasa.gov/main.html>.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

**Responsible Enterprise(s),**

**Theme(s)**

Earth Science Enterprise, ESS

**APG 3Y21: Increase understanding of the extent that long-term climate trends can be assessed or predicted.**

**Rating: Green**

**Accomplishments**

NASA achieved this APG by documenting quantitative analyses of climate forcings and climate change trends in many peer-reviewed journals. In particular, a new estimation of the global ocean heat content, which is a measure of energy “imbalance” in the climate

system, is an important contribution to the increased understanding of long-term climate trends. The Goddard Institute for Space Studies (GISS) is continuing a systematic approach to identify the individual contribution of various climate forcings and feedbacks. GISS is also working to determine the precise state of the climate system. For example, GISS estimates that Earth was out of radiation balance by about 0.18 W/m<sup>2</sup> in 1951 and is now out of balance by about 0.75 W/m<sup>2</sup>. This energy imbalance, or residual climate forcing, is a consequence of deep ocean mixing of heat anomalies. The history of climate forcings is a crucial measure of the state of the climate system and the GISS climate model has been used in the projection of long-term climate trends.

<b>Source Information</b>	<ul style="list-style-type: none"> <li>• A complete list of publications is available at <a href="http://www.giss.nasa.gov/gpol/">http://www.giss.nasa.gov/gpol/</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Earth Science Enterprise, ESS

**APG 3Y22:** *Increase understanding of the extent that future atmospheric chemical impacts on ozone and climate can be predicted by meeting at least 2 of 3 performance indicators.* **Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG by meeting three of three performance indicators.</p> <ol style="list-style-type: none"> <li>① NASA used the latest AGAGE data on tropospheric abundances of industrial halocarbons together with industry production figures to evaluate the accuracy of use/release models and to examine pollution events as indicators of unreported production.</li> <li>② NASA-funded laboratory experiments yielded information on the degradation rates and mechanisms of numerous ozone- and climate-related trace gases. This data was essential input for a comprehensive re-evaluation of OH + halocarbon reactions conducted by the NASA Panel for Data Evaluation. This latest data evaluation also provided input data for model calculations of trace gas emission scenarios conducted for recent ozone and climate assessments. The tropospheric analysis laid down systematic criteria for tropospheric model evaluation in future assessments.</li> <li>③ The Global Modeling Initiative (GMI) integrated and tested both a stratospheric and tropospheric version of a chemical transport model utilizing different input meteorology and algorithms. Comparison of simulations with stratospheric and tropospheric data yielded criteria for model evaluation and will contribute to improved assessment of future anthropogenic impact on stratospheric and tropospheric ozone and aerosols.</li> </ol>
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<b>Source Information</b>	<ul style="list-style-type: none"> <li>• NASA AGAGE Network data is archived at the Carbon Dioxide Information and Analysis Center at the U.S. Department of Energy, Oak Ridge National Laboratory.</li> <li>• NASA Data Panel evaluations are available at <a href="http://jpldataeval.jpl.nasa.gov/">http://jpldataeval.jpl.nasa.gov/</a>.</li> <li>• GMI data is available through the GMI project scientist and program manager.</li> </ul>
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<b>Responsible Enterprise(s), Theme(s)</b>	Earth Science Enterprise, ESS
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**APG 3Y23:** *Increase understanding of the extent that future concentrations of carbon dioxide and methane and their impacts on climate can be predicted.* **Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG by competing a solicitation for new studies to develop carbon cycle models for predictive uses in its interdisciplinary science. NASA has been investing in the development of advanced carbon cycling and biogeochemical cycling models for over a decade but predictive modeling for projecting future atmospheric concentrations of greenhouse gases has only recently been emphasized as a future goal. Therefore, it is too early to expect published products and documented outcomes.</p>
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**Source Information** • The NASA Interdisciplinary Science solicitation (NRA-03-OES-03) results are available at [http://research.hq.nasa.gov/code\\_y/code\\_y.cfm](http://research.hq.nasa.gov/code_y/code_y.cfm).

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**Responsible Enterprise(s),  
Theme(s)** Earth Science Enterprise, ESS

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**APG 3Y26:** *Successfully develop and infuse technologies that will enable future science measurements, and/or improve performance as well as reduce the cost of existing measurements. Increase the readiness of technologies under development, retiring risks, and advancing them to a maturity level where they can be infused into new missions with shorter development cycles. Success will equate to meeting 3 of 4 performance indicators.*

**Rating: Green**

**Accomplishments** NASA achieved this APG by meeting all four performance indicators.

- ① The New Millennium Program (NMP) Earth Observing (EO-1) mission continued its testbed phase. A significant performance advancement for NMP technologies was the agreement to validate the Space Technology 6 (ST6) Autonomous Sciencecraft Experiment (ASE) on EO-1. The technology development program element is measured based on metrics designed to ensure the selection, development and adoption of technologies, which will enable mission success and serve national priorities.
- ② The NMP program successfully advanced 43 percent of the above-referenced technologies at least one Technology Readiness Level (TRL).
- ③ NASA infused technologies into aircraft science campaigns, space flight missions, and ground system information processing.
- ④ NASA also enabled new measurements or significantly enhanced the performance of existing measurements.

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**Source Information** • Earth Science Technology Office databases, which are updated periodically with TRL status, and bimonthly and/or annual reports. For more information on this data, please contact the Office of Earth Science at NASA Headquarters.

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**Responsible Enterprise(s),  
Theme(s)** Earth Science Enterprise, ESS

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**APG 3Y27:** *Develop hardware/software tools to demonstrate high-end computational modeling to further our understanding and ability to predict the dynamic interaction of physical, chemical, and biological processes affecting the earth. Success will equate to meeting 2 of 3 indicators.*

**Rating: Green**

**Accomplishments** NASA achieved this APG by meeting all three performance indicators.

- ① NASA developed a software library, the Earth System Modeling Framework (ESMF), to support a wide variety of Earth system models in FY 2004. By focusing on critical functionality, the ESMF infrastructure is expected to enable numerous climate models to exploit the architectural limits of existing and planned computer systems including scaling out to and beyond 512 processors.
- ② NASA demonstrated quasi-operational usage of the high performance Finite Volume Data Assimilation System (fvDAS) at rates much greater than 30 days per day of data assimilation throughput on a large SGI O3K system.
- ③ NASA successfully demonstrated an increase in sustained high-end computing performance over the present level of 100 gigaflops. The solid Earth model DYNAMO demonstrated sustained high-end computing performance exceeding 100 gigaflops, which consistently simulates the time evolution of Earth's magnetic field and can achieve 200 gigaflops on 512 processors of the Alpha cluster. Time to solution, not gigaflops, is now the preferred computer usage metric of the Earth science user community.

<b>Source Information</b>	<ul style="list-style-type: none"> <li>• The ESMF is a community effort and the prototype is available at <a href="http://www.esmf.ucar.edu/">http://www.esmf.ucar.edu/</a>.</li> <li>• Performance data was drawn from project status and annual reporting, acquired from persons directly involved with the above-referenced projects. For more information on this data, please contact the Office of Earth Science at NASA Headquarters.</li> </ul>
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<b>Responsible Enterprise(s), Theme(s)</b>	Earth Science Enterprise, ESS
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<b>APG 3Y28: <i>Develop baseline suite of multidisciplinary models and computational tools leading to scalable global climate simulations.</i></b>	<b>Rating: Yellow</b>
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<b>Accomplishments</b>	<p>NASA failed to achieve this APG, although progress was significant.</p> <ul style="list-style-type: none"> <li>■ NASA partially demonstrated Earth science modeling codes interoperating on a functioning Modeling Framework early prototype via ESMF. The ESMF is a national-scale collaboration to build a software infrastructure that allows weather and climate model components from different researchers to operate together on parallel supercomputers. The partners are NASA, NOAA, NSF, and Department of Energy. This is funded via three awards and coordinated by shared milestones.</li> <li>■ NASA partially demonstrated a doubling of performance over FY 2002 in the following suites of multidisciplinary models or computational tool sets that support the Earth Science Research Strategy: <ul style="list-style-type: none"> <li>a. The Land Information Systems (LIS) team achieved substantial performance gains, although the impact of our in-house cluster relative to other systems is not yet fully quantified. The Global Land Data Assimilation System code was optimized and performance tested at both 1/4-degree and 5-kilometer resolutions, as part of the European Science and Technology Observatory (ESTO)/Computational Technologies (CT) Round-3 Land Information System investigation. The LIS/Global Land Data Assimilation Systems codes support initialization of NASA/GMAO's Seasonal to Interannual Prediction models and NOAA/NCEP's global and regional weather forecasting efforts.</li> <li>b. The ESMF-funded Massachusetts Institute of Technology cluster achieved at least a doubling of performance for ocean carbon experiments compared to the past mode of execution.</li> <li>c. NASA recently upgraded DYNAMO code with CT-sponsored computational technologies. DYNAMO models the Earth's core and derives the time evolution of the Earth's magnetic field via direct numerical simulation of magneto-hydrodynamics using pseudo-spectral methods. This year, we more than doubled the performance the code achieved one-year ago.</li> </ul> </li> </ul>
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<b>Corrective Actions</b>	Although the first performance indicator is about six months late, the ESMF project has been considered highly successful to date. Due to the large number of institutions involved in the project, the ESE management is taking extra steps to ensure the conformance of the project to every milestone in the documented agreement.
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<b>Source Information</b>	<ul style="list-style-type: none"> <li>• ESMF project history, milestones, documents, and source code are available at <a href="http://www.esmf.ucar.edu">http://www.esmf.ucar.edu</a> and <a href="http://webserv.gsfc.nasa.gov/ESS/">http://webserv.gsfc.nasa.gov/ESS/</a>.</li> <li>• The ESMF project submitted a peer-reviewed paper to <i>IEEE Computer in Science and Engineering</i> magazine to be published later in 2003.</li> </ul>
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<b>Responsible Enterprise(s), Theme(s)</b>	Earth Science Enterprise, ESS
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**APG 3Y30: Successfully develop one (1) spacecraft and have ready for launch. Operate instruments on orbiting spacecraft to enable Earth Science research and applications goals and objectives.** **Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG.</p> <ul style="list-style-type: none"> <li>■ NASA successfully developed and launched two Earth observing satellites (the ICESat and SORCE missions). The instruments on these satellites will add to the 16 existing operating missions in orbit and continue to provide users with volumes of information and data.</li> <li>■ NASA kept 93 percent of the total on-orbit instrument complement functional throughout the fiscal year.</li> </ul>
<b>Source Information</b>	<ul style="list-style-type: none"> <li>• The ESE Program Planning and Development Division mission status list is available at <a href="http://gaia.hq.nasa.gov/ease_missions/default.cfm?transaction=Enter_ESE_Missions">http://gaia.hq.nasa.gov/ease_missions/default.cfm?transaction=Enter_ESE_Missions</a>.</li> <li>• The Icesat mission website is available at <a href="http://icesat.gsfc.nasa.gov/intro.html">http://icesat.gsfc.nasa.gov/intro.html</a>.</li> <li>• The SORCE mission website is available at <a href="http://lasp.colorado.edu/sorce/">http://lasp.colorado.edu/sorce/</a>.</li> <li>• A list of all operating satellites is available at <a href="http://gaia.hq.nasa.gov/ease_missions/lau_select.cfm">http://gaia.hq.nasa.gov/ease_missions/lau_select.cfm</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Earth Science Enterprise, ESS

**APG 3Y31: Successfully disseminate Earth Science data to enable our science research and applications goals and objectives. Success will equate to meeting 4 of 5 performance indicators.** **Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG by meeting four of five performance indicators.</p> <ol style="list-style-type: none"> <li>① NASA made ESE acquired data and information on Earth's atmosphere, land and/or oceans available to users within three to five days of their request. The average delivery time for all ESE products for FY 2003 was within a day, and is projected to remain at that nominal average. However, corruption on one ESE system caused less than one percent of data to experience a delayed delivery time of up to 16 days during August 2003.</li> <li>② NASA increased the total volume of data acquired by and available from NASA for its research programs. The FY 2003 performance target was 1.18–1.27 Petabytes. By the end of July 2003, the volume of data added to the archives was at 1.52 Petabytes, exceeding the target.</li> <li>③ NASA produced and distributed scientifically valid data sets from the Aqua mission in a provisionally validated state. (Provisional products are considered partially validated while improvements to the quality are continuing. Provisional products are viewed as early science validated products and are useful for exploratory and process scientific studies. Quality may not be optimal since validation and quality assurance are ongoing. Users are expected to review product quality summaries before publication of results.)</li> <li>④ NASA maintained the overall level of ESE data center customer satisfaction, as measured by User Working Group surveys.</li> </ol>
<b>Source Information</b>	<ul style="list-style-type: none"> <li>• NASA GSFC project management for the Earth Observing System Data and Information System (EOSDIS) supports a database that collects metrics from the Distributed Active Archive Center (DAAC). DAAC data is available at <a href="http://edgrs.gsfc.nasa.gov:8000/">http://edgrs.gsfc.nasa.gov:8000/</a> and <a href="http://sps0.gsfc.nasa.gov/edgrs/">http://sps0.gsfc.nasa.gov/edgrs/</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Earth Science Enterprise, ESS

**APG 3Y32: Safely operate airborne platforms to gather remote and in situ Earth science data for process and calibration/validation studies.** **Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG by supporting and executing seasonally dependent coordinated research field campaigns within two weeks of target departure with the aid of airborne and sub-orbital platforms, as scheduled at the beginning of the fiscal year. All missions</p>
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conducted on airborne platforms were completed safely and achieved data collection objectives. Priority was established based on scientific importance, seasonal factors, the presence of collaborative observing teams, and satellite validation needs.

<b>Source Information</b>	<ul style="list-style-type: none"> <li>• NASA headquarters program files (from program manager to performing organizations) designated the priority campaigns for FY 2003.</li> <li>• FY 2003 ESE Aircraft Program Schedules in program files.</li> <li>• Daily flight reports and mission summaries in project files at the performing Centers.</li> </ul>
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<b>Responsible Enterprise(s), Theme(s)</b>	Earth Science Enterprise, ESS
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**Objective 1.2 Expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology.**

**APG 3Y24: Provide regional decision-makers with scientific and applications products and tools.** **Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG.</p> <ul style="list-style-type: none"> <li>■ NASA identified two common information requirements that address constituent user needs: a) measurements of wind speed and direction combined with precipitation and, b) monitoring and modeling of initiation and transport of atmospheric constituents. NASA developed plans to address these requirements and successfully move applications in those areas toward operational use. <ul style="list-style-type: none"> <li>a. The Earth Science Applications program: 1) worked with the NOAA National Centers of Environmental Prediction to benchmark the use of QuikSCAT (wind speed) and TRMM (precipitation) to improve prediction of hurricane intensity and tracking; and, 2) collaborated with the Federal Aviation Administration (FAA) and NOAA on using MODIS data from Terra and Aqua to monitor and model initiation and transport of volcanic ash, and its impact on aviation safety.</li> </ul> </li> <li>■ NASA verified and validated technology, algorithms, and scientific results in partnership with selected commercial partners. <ul style="list-style-type: none"> <li>a. NASA, the National Imaging and Mapping Agency (NIMA), and U.S. Geological Survey through the Joint Agency Committee on Imagery Evaluation (JACIE), collaborated to verify and validate the high-resolution optical remote sensing technology and data provided by DigitalGlobe's Quickbird satellite.</li> <li>b. NASA and the Federal Emergency Management Agency (FEMA) collaborated on a joint project to verify and validate the performance of lidar data as a source of high accuracy elevation information for incorporation into flood risk models and to improve the performance of the FEMA HAZUS DSS.</li> </ul> </li> <li>■ NASA implemented over twenty demonstration projects including: <ul style="list-style-type: none"> <li>a. Fifteen proposals under the State, Local, and Tribal Government Broad Area Announcement (BAA).; and</li> <li>b. Ten projects under the Carbon Cycle NASA Research Announcement.</li> </ul> </li> </ul>
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<b>Source Information</b>	<ul style="list-style-type: none"> <li>• FAA Oceanic Weather Project <a href="http://www.rap.ucar.edu/asr2001/K-oceanic_weather.htm">http://www.rap.ucar.edu/asr2001/K-oceanic_weather.htm</a>.</li> <li>• TRMM Web site: <a href="http://trmm.gsfc.nasa.gov/">http://trmm.gsfc.nasa.gov/</a>.</li> <li>• <a href="http://www.esa.ssc.nasa.gov/background_documents/volcanic_ash_monitoring_for_aviation.doc">http://www.esa.ssc.nasa.gov/background_documents/volcanic_ash_monitoring_for_aviation.doc</a>.</li> <li>• Additional sources for this APG are available at <a href="http://www.ifmp.nasa.gov/codeb/library/reports.htm">http://www.ifmp.nasa.gov/codeb/library/reports.htm</a>.</li> </ul>
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<b>Responsible Enterprise(s), Theme(s)</b>	Earth Science Enterprise, ESA
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**Objective 1.3 Understand the origins and societal impacts of variability in the Sun-Earth connection.**

Note: APGs 3S7, 3S8, 3S9, 3S10, and 3S11 are included under both Goal 1 and Goal 5.

**APG 3S7:** Earn external review rating of “green,” on average, on making progress in the following research focus areas: Understand the origins of long- and short-term solar variability. Understand the effects of solar variability on the solar atmosphere and heliosphere. Understand the space environment of Earth and other planets. **Rating: Green**

**Accomplishments** NASA achieved this APG, as assessed by the Space Science Advisory Committee’s external review.

- NASA combined information from the Ramaty High Energy Solar Spectroscopic Imager (RHESSI), the Transition Region and Coronal Explorer (TRACE), and the European Space Agency (ESA)-NASA Solar and Heliospheric Observatory (SOHO) spacecraft and confirmed one theory about high-speed solar eruptions: energy is stored in the low solar corona by magnetic confinement and is abruptly released through reconnection.
- A sounding rocket instrument observed fine structure less than 100 kilometers across in the extreme ultraviolet, shrinking the upper limit for the Sun’s magnetic “building blocks.”
- Data from the Themosphere, Ionosphere, Mesosphere, Energetics and Dynamics (TIMED) spacecraft showed that greatly increased radiation from a minor constituent, nitric oxide, helps cool the upper atmosphere back to normal temperatures after the increased energy is deposited into Earth’s upper atmosphere by solar activity (which should make it much hotter than normal).
- NASA obtained expected data from 100 percent of the operating missions supporting these research areas.

**Source Information**

- A report of the external expert review is available at <http://spacescience.nasa.gov/adv/minutes/min0308.pdf>.
- Operating mission results are available at <http://spacescience.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

**Responsible Enterprise(s), Theme(s)** Space Science Enterprise, SEC

**APG 3S8:** Earn external review rating of “green,” on average, on making progress in the following research focus areas: Understand forces and processes, such as impacts, that affect habitability of Earth. Develop the capability to predict space weather. Find extraterrestrial resources and assess the suitability of Solar System locales for future human exploration. **Rating: Green**

**Accomplishments** NASA achieved this APG, as assessed by the Space Science Advisory Committee’s external review.

- NASA-funded searches are believed to have now found over half of the existing dangerous 1+ kilometer near-Earth objects, and observations of binary asteroids have indicated that most asteroids are like rubble piles, not solid objects.
- Relevant to space weather, researchers developed the first complete model for a coronal mass ejection shock, the acceleration of particles, and transport of the particles to Earth.
- Mars Odyssey data show that the upper meter of some areas of Mars is dominated by ice, which is very important for possible future human exploration.
- NASA obtained expected data from 100 percent of the operating missions supporting these research areas.

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**Source Information**

- A report of the external expert review is available at <http://spacescience.nasa.gov/adv/minutes/min0308.pdf>.
- Operating mission results are available at <http://spacescience.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

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**Responsible Enterprise(s),****Theme(s)**

Space Science Enterprise, SEC, SSE, MEP

*This APG also applies to Objective 1.4.*

**APG 3S9:** *Earn external review rating of “green” on making progress in the following area: Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives.*

**Rating: Yellow****Accomplishments**

NASA failed to achieve this APG although progress was significant. NASA achieved six of eight (75%) “major program/project” performance objectives and three of six (50%) applicable objectives for “other projects.” This meets the established threshold of 75 percent for major programs and projects, but does not meet the “majority” threshold for “other projects.”

- Major Programs/Projects progress:
  - a. NASA completed thermal vacuum testing of the Cosmic Origins Spectrograph (COS) one month late in October 2003. The COS will be installed on the fourth Hubble Space Telescope (HST) servicing mission.
  - b. NASA completed the aircraft fuselage structural modification, continuing progress toward telescope installation, for the Stratospheric Observatory for Infrared Astronomy (SOFIA).
  - c. The Gravity Probe-B (GP-B) spacecraft, which will test Einstein’s general theory of relativity, was not launched due to technical problems uncovered during integrated testing. GP-B is now scheduled for launch in FY 2004.
  - d. NASA launched the twin Mars Exploration Rovers.
  - e. NASA completed Critical Design Review (CDR) for the Mars Reconnaissance Orbiter.
  - f. NASA completed CDR for the Solar Terrestrial Relations Observatory (STEREO) twin spacecraft, which will study solar activity.
  - g. NASA completed CDR for the Gamma-ray Large Area Space Telescope (GLAST) which will yield valuable information about the birth and early evolution of the universe.
  - h. NASA began integration and testing of the Mercury Surface, Space Environment, Geochemistry and Ranging (MESSENGER) spacecraft.
- Other Projects progress:
  - a. Spacecraft integration on the Full-sky Astrometric Mapping Explorer (FAME) was not pursued due to the fact that in FY 2002 the mission was not confirmed to proceed into development.
  - b. NASA completed the payload module for the Coupled Ion-Neutral Dynamics Investigations (CINDI).
  - c. NASA conducted Integration and Test Readiness Review for Deep Impact.
  - d. NASA completed Spectral and Photometric Imaging Receiver Qualification Model Detectors for the Herschel mission.

*Delayed progress in other projects:*

  - e. NASA delayed progress on instrument payload module and spacecraft integration for Swift until FY 2004.
  - f. NASA delayed progress on conducting the pre-environmental review for the X-ray Telescope (XRT) Instrument for the Solar-B mission.

g. NASA delayed progress on completion of the Cryocooler Qualification Model for the Planck mission.

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**Corrective Actions**

- Other Projects
  - a. Swift spacecraft integration was delayed due to correction of improper wiring on the Burst Alert Telescope (BAT) instrument. Integration is now scheduled for November 2003. Changes in quality assurance procedures and personnel assignments have been made to guard against such problems in the future.
  - e. The Japanese space agency, ISAS, slipped the schedule for the Solar-B mission by one year. NASA is supplying components of three instruments and has adjusted schedules accordingly.
  - f. Technical challenges slowed progress on Planck, and the Cryocooler Qualification Model is now scheduled for completion in FY 2004.

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**Source Information**

- Program and project schedule reports, and related NASA press releases are available at <http://space.science.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

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**Responsible Enterprise(s),**

**Theme(s)**

Space Science Enterprise, ASO, MEP, SEC, SEU, SSE

*This APG also applies to Objective 1.4.*

**APG 3S10:** Earn external review rating of "green" on making progress in the following technology development area: Focus (advance) technology development on a well-defined set of performance requirements covering the needs of near-term to mid-term strategic plan missions. **Rating: Green**

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**Accomplishments**

- NASA achieved this APG by meeting seven of nine (78%) technology development performance objectives. (The indicator for the goal was to meet no fewer than 66 percent of the following objectives.)
- NASA completed and documented final analysis of the Advanced Mirror System for the James Webb Space Telescope (formerly the Next Generation Space Telescope), the follow-on mission to the Hubble Space Telescope.
  - The previously planned task for the StarLight mission was not pursued due to the fact that the flight demonstration was terminated in FY 2002; however, the effort continues as ground-based technology development in support of formation-flying interferometry under the umbrella of the Terrestrial Planet Finder project.
  - NASA completed Phase 1 X-2000 hardware.
  - NASA selected Phase II awards for electric propulsion technology development (in late FY 2002, earlier than anticipated) for the In-Space Propulsion mission for electric propulsion technology development.
  - NASA completed Phase A studies for the Mars 2007 Scout mission with the selection of Phoenix, which will study the planet's polar ice cap.
  - NASA completed the award of the Future Solar Terrestrial Probes instrument contract with the selection of two Phase A studies for the Magnetospheric Multiscale instrument.
  - NASA completed the Initial Confirmation Review (Phase A to Phase B transition) for the Solar Dynamics Observatory, which will advance our understanding of the Sun's influence on Earth.
  - NASA completed the Spectroscopy X-ray Telescope (SXT) Optics Engineering Unit as part of the Constellation-X Project, but testing was delayed due to problems with the ground support equipment.
  - NASA completed an initial Phase A study with the issuance of its Technology Readiness Implementation Report for the Laser Interferometer Space Antenna (LISA) mission, which is dedicated to the search for gravitational waves.

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**Source Information** • Program and project schedule reports, and related NASA press releases are available at <http://space.science.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

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**Responsible Enterprise(s),**

**Theme(s)** Space Science Enterprise, ASO, MEP, SEC, SEU, SSE

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*This APG also applies to Objective 1.4.*

**APG 3S11:** *Earn external review rating of “green” on making progress in the following technology validation area: Formulate and implement cost-effective space demonstrations of selected technologies on suitable carriers.*

**Rating: Green**

**Accomplishments**

NASA achieved this APG by meeting two of three (67%) flight validation performance objectives:

- NASA successfully completed Critical Design Reviews (CDR) for the Space Technology (ST)-6 Autonomous Sciencecraft Experiment and Inertial Stellar Compass.
- NASA successfully completed the Confirmation Review for the ST-7 Disturbance Reduction System allowing the project to proceed with implementation.
- Completion of the Space Technology-8 (ST-8) initial confirmation was delayed due to an earlier delay in the release of the ST-8 NASA research announcement.

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**Source Information**

Program and project schedule reports, and related NASA press releases are available at <http://space.science.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

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**Responsible Enterprise(s),**

**Theme(s)** Space Science Enterprise, ASO, MEP, SEC, SEU, SSE

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*This APG also applies to Objective 1.4.*

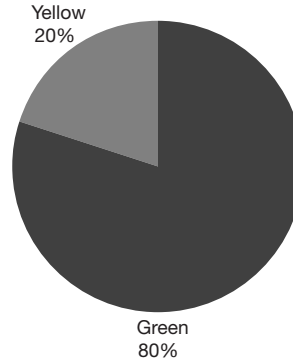
### **Objective 1.4 Catalog and understand potential impact hazards to Earth from space.**

APGs that apply to this Objective are reported in:

APGs 3S8, 3S9, 3S10 and 3S11 under Objective 1.3.

**Goal 2:** Enable a safer, more secure, efficient, and environmentally friendly air transportation system.

*In FY 2003, NASA achieved four of five annual performance goals (APGs) under Goal 2. Significant strides in one of the APGs resulted in a "yellow" rating.*



**Objective 2.1 Decrease the aircraft fatal accident rate, reduce the vulnerability of the air transportation system to hostile threats, and mitigate the consequences of accidents and hostile acts.**

**APG 3R1:** *Demonstrate progress in maturing, through flight tests and/or simulations, the critical technologies that will be necessary to meet the aviation safety objective. These tests and simulations are critical steps in the development of a suite of technologies that when completely developed and implemented by the customer, will provide a minimum of 50 percent reduction in fatal accident rate.*

**Rating: Yellow**

<b>Accomplishments</b>	NASA failed to achieve this APG, although progress was significant and, based on current projections, the goal of enabling a 50 percent reduction in the fatal accident rate will be met. <ul style="list-style-type: none"> <li>■ NASA developed software systems for an advanced fuel measurement system, and developed a neural network verification software tool.</li> <li>■ NASA evaluated the effects of neutron particles on flight critical systems, and demonstrated a Smart Icing System that detects, mitigates, and provides feedback to pilots.</li> </ul>
<b>Corrective Actions</b>	As a result of the aircraft safety stand-down at Langley Research Center (LaRC), several flight tests of safety technologies were delayed. Upon return of the LaRC 757 to flight status, the flight tests will resume, the testing and associated milestones will be completed, and the slippage is not expected to impact the successful accomplishment of the program objective.
<b>Source Information</b>	• Data for this APG is available at <a href="http://avsp.larc.nasa.gov/">http://avsp.larc.nasa.gov/</a> .
<b>Responsible Enterprise(s), Theme(s)</b>	Aerospace Technology Enterprise, AT

**Objective 2.2 Protect local and global environmental quality by reducing aircraft noise and emissions.**

**APG 3R2:** *Complete combustor sector test for concepts capable of achieving the 70% NOx goal by 2007 and select the most promising approaches leading to full annular rig testing for large and regional jet engine applications. Complete an Interim Technology Assessment of the aggregate potential benefits from the engine and airframe technologies to reduce emissions. The results from this analysis will provide a benchmark for measuring overall progress, and guide future investment decisions.*

**Rating: Green**

<b>Accomplishments</b>	NASA achieved this APG. <ul style="list-style-type: none"> <li>■ NASA completed combustor sector tests of two different technologies for large engines. The data is still being analyzed.</li> </ul>
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- NASA completed one test program (another is in progress) for regional jet aircraft emission reduction technologies. Preliminary assessment of the data from both the large and regional sized engines is promising and increases the confidence that the outcome objective can be achieved. Based on the results of the sector tests, NASA will select the technologies that will continue development and be included in a full annular test by the end of the year.

<b>Source Information</b>	• Data for this APG is available at <a href="http://www.ueet.nasa.gov/">http://www.ueet.nasa.gov/</a> .
<b>Responsible Enterprise(s), Theme(s)</b>	Aerospace Technology Enterprise, AT

**APG 3R3:** *Complete development of initial physics-based prediction models to guide the development potential noise reduction technology concepts. Complete an interim technology assessment of the potential benefits for these concepts to reduce noise emissions. The results from this analysis will provide a benchmark for measuring overall progress, and guide future investment decisions.*

**Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG.</p> <ul style="list-style-type: none"> <li>■ NASA completed an interim technology assessment that acts as a program decision point for what technologies are taken to further maturation. The decision is made by assessment of the impact of the technologies on both a component and system level towards the overall noise goals and their estimated contributions. <ul style="list-style-type: none"> <li>a. NASA developed initial physics-based noise prediction models that will provide the capability for predicting aviation noise sources including: the effects of flap, slat, and landing gear noise; fuselage and wing shielding effects; physics-based fan noise; and propagation of engine noise within a nacelle. This will allow the identification of a suite of technologies that will have the highest probability of meeting NASA’s noise reduction objective.</li> </ul> </li> </ul>
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<b>Source Information</b>	• To obtain the data used for the evaluation, contact the Vehicle Systems Program’s Quiet Aircraft Technology project office at Langley Research Center.
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<b>Responsible Enterprise(s), Theme(s)</b>	Aerospace Technology Enterprise, AT
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**Objective 2.3 Enable more people and goods to travel faster and farther, with fewer delays.**

**APG 3R4:** *Complete development, initial functionality and evaluate human factors for at least one decision support tool to enable achievement of the planned progress towards the goal of doubling the capacity of the National Airspace System in 10 years. Complete the initial build of a toolbox of state-of-the-art airspace models to enable the planned progress towards the 2022 Objective.*

**Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG.</p> <ul style="list-style-type: none"> <li>■ NASA completed development, demonstration of initial functionality, and evaluation of human factors for a Multi-Center Traffic Management Advisor (McTMA) decision support tool for complex airspace. McTMA simulation results indicated: a) metering for Philadelphia appears viable in Boston Air Traffic Control Center (ARTCC); b) more delay absorption capacity exists in Boston ARTCC than New York or Washington ARTCCs; c) McTMA’s internal departure scheduling is important; and d) significant metering issues exist in Boston ARTCC.</li> <li>■ NASA completed development, demonstration of initial functionality, and evaluation of human factors for active terminal-area Expedite Departure Path decision-support tool.</li> </ul>
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- NASA completed and validated a state-of-the-art airspace model toolbox, the Airspace Concept Evaluation System, with the ability to assess the economic impact of new technology and National Airspace System operational performance, and the ability to model the dynamic effects of interactive agents.
- NASA provided strategies for improving training and procedures to reduce misunderstandings between pilots and air traffic controllers.

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<b>Source Information</b>	• To obtain the data used for the evaluation, contact the Airspace Systems Program Office.
<b>Responsible Enterprise(s),</b>	
<b>Theme(s)</b>	Aerospace Technology Enterprise, AT

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**APG 3R5:** *Select candidate technologies for experimental flight evaluation based on their impact on mobility. Mobility metrics will be measured by accessibility, doorstep-to-destination transit time, system and user costs, and related trip reliability and safety metrics. These flight experiments will evaluate individually, at the sub-system level, the impact of selected technologies on lowering required landing minimums and increasing the volume of operations at non-towered landing facilities in non-radar airspace during instrument meteorological conditions.*

**Rating: Green**

**Accomplishments** NASA (as part of the NASA/FAA/National Consortium of Aviation Mobility SATS Alliance) achieved this APG by agreeing to the suite of technologies and procedures to be included in the project flight experiments. The technologies and the procedures include: a) Higher Volume Operations (sequencing and self-separation algorithms); b) Lower Landing Minima (synthetic vision with highway-in-the-sky and velocity-vector guidance, enhanced vision, heads-up display); c) Single Pilot Performance (integrity monitoring, decision aiding); and d) En Route Integration (procedures for facilitating air traffic controller interaction).

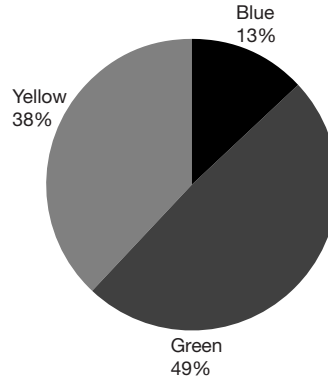
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<b>Source Information</b>	• To obtain the data used for the evaluation, contact the Airspace Systems Program Office.
<b>Responsible Enterprise(s),</b>	
<b>Theme(s)</b>	Aerospace Technology Enterprise, AT

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**Goal 3:** Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.

*In FY 2003, NASA achieved or exceeded five of eight annual performance goals (APGs) under Goal 3. Significant strides in the other three APGs resulted in a “yellow” rating.*



**Objective 3.1 Enhance the Nation’s security through partnerships with DOD, DHS and other U.S. or international government agencies.**

**APG 3Y29:** Collaborate with other domestic and international agencies in developing and implementing better methods for using remotely sensed observations to support national and international assessments of climate changes and their practical consequences. Success will equate to meeting 4 of 5 performance indicators.

**Rating: Green**

**Accomplishments**

NASA achieved this APG by meeting all five performance indicators.

- ① NASA continued collaborative relations with Federal agencies to promote the use of remotely sensed data and information to accomplish U.S. strategic scientific, environmental, and economic objectives.
- ② NASA cooperated with international agencies to promote the use of remotely sensed data and information to accomplish U.S. strategic scientific, environmental, and economic objectives through nationally and internationally recognized interagency projects, such as the Climate Change Science Program, the Climate Change Technology Program, the Commercial Remote Sensing Policy Implementation Group, Geospatial One Stop, and the Earth Observation Task Group.
- ③ NASA demonstrated enhanced interoperability and interconnectivity of international remote sensing information systems and services through its continued participation in the Committee on Earth Observation Satellites (CEOS) Working Group on Information Systems and Services.
- ④ NASA demonstrated enhanced mission coordination and complementarity of remote sensing data through NASA’s continued participation in the CEOS Working Group on Calibration and Validation.
- ⑤ NASA demonstrated an international approach to an integrated global observing strategy for the oceans and the terrestrial carbon cycle by participating in the Integrated Global Observing Strategy–Partners (IGOS-P).

**Source Information**

- Earth Observation Summit data is available at <http://www.earthobservationsummit.gov>.
- *The Socio-Economic Value of Improved Weather and Climate Information*, The Space Policy Institute at George Washington University. Williamson, et al., December 2002. Available at <http://www.gwu.edu/~spi/Socio-EconomicBenefitsFinalREPORT2.pdf>.
- Geospatial One Stop data is available at <http://www.geodata.gov>.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

**Responsible Enterprise(s),**

**Theme(s)**

Earth Science Enterprise, ESA

**Objective 3.2 Improve the Nation’s economic strength and quality of life by facilitating innovative use of NASA technology.**

Note: APG3B8 is included under both Goal 3 and Goal 4.

**APG 3B8:** *In close coordination with the research community, allocate flight resources and develop facilities to achieve a balanced and productive research program.* **Rating: Green**

**Accomplishments** NASA achieved this APG, as assessed by the Biological and Physical Research Advisory Committee’s external review.

- NASA completed Phase A definition studies associated with awarding a contract to manage ISS utilization to a Non-Government Organization (NGO) to the International Space Station Research Institute.
- NASA coordinated and participated with the scientific community to define ISS research by developing the Biological and Physical Research Enterprise (BPRE) research plan, detailed research roadmaps, and development of BPRE Strategies. The research plan presents the mission, past accomplishments, priorities, and the intended direction for scientific investigations. Coordinated an open competitive research announcement process.
- NASA implemented a cross-discipline approach to providing balanced resource allocations and flight opportunities on the Russian Soyuz and Progress launch systems as reflected in the ISS Partner Utilization Plan. All facility development is continuing toward established Flight Hardware Availability dates to insure readiness of BPRE equipment as we return to flight.
- NASA deployed ISS research facilities on-orbit consistent with budget constraints and BPRE prioritization, utilizing six racks: Human Research Facility (HRF)-1, the Microgravity Science Glovebox (MSG), and the Expedite the Processing of Experiments to the Space Station (EXPRESS) Racks 1, 2, 3A, and 4.

**Source Information** • Data for this APG is available at <http://www.spaceresearch.nasa.gov> and [http://spaceresearch.nasa.gov/general\\_info/adv.html#ah](http://spaceresearch.nasa.gov/general_info/adv.html#ah).

**Responsible Enterprise(s), Theme(s)** Biological and Physical Research Enterprise, BSR, PSR, RPFS

*This APG also applies to Objective 3.3.*

**APG 3B9:** *Engage the commercial community and encourage non-NASA investment in commercial space research by meeting at least two of three performance indicators.* **Rating: Green**

**Accomplishments** NASA achieved this APG, as assessed by the Biological and Physical Research Advisory Committee’s external review, by meeting two of three performance indicators.

- ① Data on the ratio of non-NASA funding to NASA funding will not be available until January 2004.
- ② NASA brought three products (out of the 39 product lines currently under investigation) to market in FY 2003. ITD, a non-profit division of ProVision Technologies, developed two new hyperspectral sensors that were sold this year through Photon Industries. The ultraviolet sensor, (200 to 400 nanometers) is the world’s first desktop hyperspectral sensor. The FBI purchased the first system. A shortwave infrared sensor, (900 to 2500 nanometers) also was developed and sold to the FBI and U.S. Department of Agriculture (USDA). The third product poised for release and sale on the open market is the Optical Multifunctional Sensor, developed in collaboration with Integrated MicroSensors Inc. The sensor uses an optical sensor to identify chemical constituents in samples. It was field tested as part of a Mars Society simulation called the Mars Analog Research Station (MARS) project.

③ NASA established at least ten new active industrial partnerships with the Space Product Development Research Partnership Centers (formerly Commercial Space Centers) in a variety of fields including technology development, pharmaceuticals, electronics, and computer systems.

<b>Corrective Actions</b>	① The data to determine whether or not this target has been met will not be available until January 2004. We are revising our data collection system to enable a timely response by FY 2005.
<b>Source Information</b>	• Data for this APG is available at <a href="http://www.spd.nasa.gov/sourcebook/index.html">http://www.spd.nasa.gov/sourcebook/index.html</a> and through NASA's Office of Biological and Physical Research.
<b>Responsible Enterprise(s), Theme(s)</b>	Biological and Physical Research Enterprise, RPFS

**APG 3B10: Highlight ISS-based commercial space research at business meetings and conferences.** **Rating: Blue**

<b>Accomplishments</b>	NASA significantly exceeded this APG, as assessed by the Biological and Physical Research Advisory Committee's external review by supporting five business/trade conferences to highlight ISS-based commercial space research (surpassing the goal of three). NASA Space Product Development featured exhibits at the World Space Congress, National Manufacturing Week, the National Space Symposium, IBC Drug Discovery, and the BIO 2003 Convention.
<b>Source Information</b>	• Data for this APG is available at <a href="http://www.spd.nasa.gov/sourcebook/index.html">http://www.spd.nasa.gov/sourcebook/index.html</a> .
<b>Responsible Enterprise(s), Theme(s)</b>	Biological and Physical Research Enterprise, RPFS

**APG 3CK3: Enhance communication about and dissemination of technologies available for commercial use, technologies that have been commercialized by industry, and increase accessibility to targeted industry sectors by meeting 2 of 2 indicators.** **Rating: Green**

<b>Accomplishments</b>	NASA achieved this APG by meeting both performance indicators. ① NASA published three NASA-specific trade publications: <i>Aerospace Innovations</i> (three editions), <i>NASA Tech Briefs</i> (monthly) and <i>Spinoffs</i> (yearly). One edition of <i>Aerospace Innovations</i> , "Enterprise Partner to Host First NASA Medical Technology Summit" (summer 2003) focused on a NASA held event titled, "Forging Partnerships to Develop Emerging Technologies." This publication and the event targeted the medical device industry and very effectively promoted the 20 technologies for which NASA sought partnerships for licensing or collaborations. Over 130 of the leaders in the medical device industry attended and explored potential partnerships with NASA innovators. ② NASA provided public and industry access to the TechTracS database, which features approximately 21,000 NASA technologies, including technical briefs, diagrams, and illustrations for licensing and partnership development.
<b>Source Information</b>	• Data for this APG is available at <a href="http://www.nctn.hq.nasa.gov">http://www.nctn.hq.nasa.gov</a> . • The NASATechTracS data base is available at <a href="http://technology.nasa.gov/">http://technology.nasa.gov/</a> .
<b>Responsible Enterprise(s), Theme(s)</b>	Aerospace Technology Enterprise, ITTP

**Objective 3.3 Resolve scientific issues in the low gravity environment of space that enrich life on Earth by leading to better design tools in energy, materials, medical, and communication technologies.**

**APG 3B4:** *Earn external review rating of “green” or “blue” by making progress in the following research focus areas as described in the associated indicators: elucidate the detailed physical and chemical processes associated with macromolecular crystal growth and cellular assembling processes in tissue cultures.*

**Rating: Yellow**

**Accomplishments**

NASA failed to achieve this APG although progress was significant, as assessed by the Biological and Physical Research Advisory Committee’s external review.

- ① NASA produced peer-reviewed archival publications on the first ISS protein crystallization experiments.
- ② NASA analyzed ISS flight experiment results in macromolecular and cellular biotechnology via downlinked video data from the Leland Chung (Emory University) experiment on STS-107. The data was a dramatic demonstration of the effectiveness of low-gravity tissue culture in propagating large, structurally developed prostate cancer and bone cell masses.

**Corrective Actions**

The STS-107 mission loss had a serious impact on the planned scientific objectives for this goal. Macromolecular and cellular biotechnology flight research was slowed by Shuttle flight hiatus. Unanticipated budget impacts slowed research grant selection decisions in biotechnology. NASA will reassess flight opportunities and priorities as part of our return to flight process.

**Source Information**

- [http://spaceresearch.nasa.gov/general\\_info/remapreport.html](http://spaceresearch.nasa.gov/general_info/remapreport.html).
- [http://www.emory.edu/EMORY\\_MAGAZINE/spring2003/precis\\_columbia](http://www.emory.edu/EMORY_MAGAZINE/spring2003/precis_columbia).
- [http://www.winshipcancerinstitute.org/geninfo/News/Chung\\_Nasa\\_011003.htm](http://www.winshipcancerinstitute.org/geninfo/News/Chung_Nasa_011003.htm).
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

**Responsible Enterprise(s),**

**Theme(s)**

Biological and Physical Research Enterprise, PSR

**APG 3B6:** *Earn external review rating of “green” or “blue” by making progress in the following research focus area: Investigate fundamental and unresolved issues in fluid physics, and materials and combustion science using gravity as a theoretical and experimental revealing tool.*

**Rating: Yellow**

**Accomplishments**

NASA failed to achieve this APG, although progress was significant, as assessed by the Biological and Physical Research Advisory Committee’s external review.

- NASA maintained an outstanding and peer-reviewed program in fluid physics, materials science, and combustion science by completing NASA Research Announcement (NRA) selections in fluid physics and combustion science. NASA selected Principal Investigators (PIs) for ground-based research on microgravity research relevant to: microfluidics; heat transfer technology and nuclear reactor operations in space; microscale combustors for space applications, and spacecraft fire safety. NASA solicited proposals for a new research theme, propulsion materials research, to bring the expertise of the basic research community to bear on problems important to the long-term success of the space program.
- NASA employed a new annual process to solicit and select peer-reviewed, ground-based investigations in materials science, fluid physics, and combustion research.
- The loss of the STS-107 mission resulted in only partial returns of planned data for the combustion science and fluid physics experiments on board. However, the PIs have sufficient information from available down linked data to reach significant conclusions.



<b>Corrective Actions</b>	The STS-107 mission loss had a serious impact on the planned scientific objectives for this goal. Unanticipated budget impacts slowed research grant selection decisions in materials science.
<b>Source Information</b>	<ul style="list-style-type: none"> <li>• <i>Physics Today</i> featured the work of materials science PI Ken Kelton (Washington University – St. Louis) on the appearance of structure in liquids near phase transitions. The feature is available at <a href="http://www.aip.org/pt/vol-56/iss-7/current.html">http://www.aip.org/pt/vol-56/iss-7/current.html</a>.</li> <li>• <a href="http://research.hq.nasa.gov/code_u/nra/current/NRA-01-OBPR-08-C/winners.html">http://research.hq.nasa.gov/code_u/nra/current/NRA-01-OBPR-08-C/winners.html</a>.</li> <li>• <a href="http://carambola.usc.edu/research/SOFBALL2quickie.html">http://carambola.usc.edu/research/SOFBALL2quickie.html</a>.</li> <li>• Additional sources for this APG are available at <a href="http://www.ifmp.nasa.gov/codeb/library/reports.htm">http://www.ifmp.nasa.gov/codeb/library/reports.htm</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Biological and Physical Research Enterprise, PSR

*Note: APG 3H13 is included under both Goal 3 and Goal 4.*

**APG 3H13:** *Successfully complete 90% of International Space Station planned mission objectives. Achieve 90% on-orbit mission success for planned International Space Station assembly and logistics activities on the Space Shuttle flights scheduled for FY 2003. Sum total of the successfully accomplished primary mission objectives divided by the total number of mission objectives per year.*

**Rating: Yellow**

<b>Accomplishments</b>	<p>NASA failed to meet this APG, although progress was significant.</p> <ul style="list-style-type: none"> <li>■ NASA completed two of the five planned Shuttle assembly and logistics missions to ISS prior to the <i>Columbia</i> accident. Progress and Soyuz flights continued, and hardware development, testing and certification continued on schedule. Software upgrades to the ISS vehicle continued on schedule. Assembly and logistics flights will resume upon Shuttle return to flight.</li> <li>■ NASA successfully completed on-line testing of the second of the two racks for the HRF and integrated it into the Multi-Purpose Logistics Module.</li> <li>■ NASA completed stand-alone testing of the qualification rack for the Habitat Holding Rack, awaiting launch on ULF-1.</li> <li>■ NASA completed Phase 1 of integrated qualification tests with the incubator and Phase 2 has begun.</li> <li>■ NASA held the Critical Design Review (CDR) for the Fluids Integrated Rack (FIR).</li> <li>■ NASA completed verification and test review for the Combustion Integrated Rack (CIR).</li> <li>■ NASA successfully completed numerous tests including: CIR/Multi-User Droplet Combustion Apparatus (rack insert) integrated testing; FIR vibration and acoustics testing; and facility radiation and portable fire extinguisher testing.</li> <li>■ NASA completed Experiment Carrier Interface Verification Unit testing and the Master Controller combined components interface test.</li> <li>■ NASA completed cryogenic testing of all flight Super-Conducting Quantum Interface Device (SQUID) sensors.</li> <li>■ NASA held the payload interface unit acceptance review at KSC.</li> <li>■ NASA completed first flight “belly weld” of the helium dewar.</li> </ul>
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<b>Source Information</b>	<ul style="list-style-type: none"> <li>• Data for this APG is available at <a href="http://brp.arc.nasa.gov/GBL/hld_rcks.html">http://brp.arc.nasa.gov/GBL/hld_rcks.html</a>.</li> <li>• <a href="http://hrf.jsc.nasa.gov/rack2.htm">http://hrf.jsc.nasa.gov/rack2.htm</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Space Flight Enterprise, ISS, Biological and Physical Research Enterprise, BSR, PSR

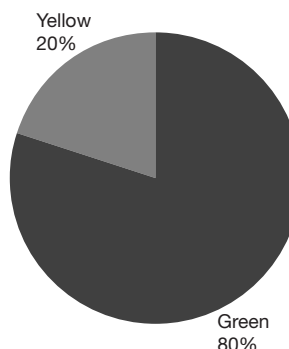
*APGs that apply to this Objective also are reported in:*

*APG 3B8 under Objective 3.2.*

## Mission II: To Explore the Universe and Search for Life

**Goal 4:** Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space.

*In FY 2003, NASA achieved four of five annual performance goals (APGs) under Goal 4.*



### Objective 4.1 Determine how fundamental biological processes of life respond to gravity and space environments.

**APG 3B7:** Earn external review rating of “green” or “blue” by making progress in the following research focus area: understand the role of gravity in biological processes at all levels of biological complexity.

**Rating: Green**

#### Accomplishments

NASA achieved this APG, as assessed by the Biological and Physical Research Advisory Committee’s external review.

- NASA maintained an outstanding, peer-reviewed program in Fundamental Space Biology (FSB) by supporting a total of 117 peer-reviewed investigations (95 ground-based and 22 flight). A total of \$31 million (62 percent of the total FSB Research and Technology budget) directly supported these investigations. FSB-funded investigators produced 224 peer-reviewed publications. Five Principal Investigators (PIs) funded through FSB were highlighted on the covers of prestigious journals including: *Nature*, *Proceedings of the National Academy of Sciences*, *Cell Cycle*, *Journal of Cell Science*, and *Journal of Neurophysiology*.
- NASA solicited ground-based research in all fundamental biology disciplines by publishing two NASA research announcements.
- NASA supported seven flight experiments on STS-107, including two that were recovered after the loss of *Columbia*:
  - a. The Development of Gravity Sensitive Plant Cells (Ceratodon) During Early Utilization of Space Station data analysis is being completed and a manuscript is being prepared for submission.
  - b. The *C. elegans* Model Specimen in Space (CEMSS)-1 demonstration was designed to establish an optimal growth media to support *C. elegans* for future ISS flight experimentation. Although the experiment canisters containing the demonstration were not recovered for weeks following the accident, the worms were found alive and in excellent condition. Thus, while not a controlled experiment, the synthetic growth media tested was found to be sufficiently robust to be considered for future *C. elegans* flight opportunities that will be openly competed.
- NASA determined baseline data requirements for model specimens to be used on ISS by:
  - a. Leading an International Space Life Sciences Working Group (ISLSWG) workshop to determine the optimal requirements for flight research using the model organism *C. elegans*.
  - b. Participating in an International Space Life Sciences Working Group (ISLSWG) workshop hosted by ESA to determine the optimal requirements for flight research using

the model plant Arabidopsis. The workshop presented plant scientists with a description of available facilities, additional supporting resources (e.g., cold stowage), and logistics operations suitable to conduct Arabidopsis experiments on ISS. Requirements for other highly desirable plant species, such as Brassica, also were discussed and documented.

- NASA planned for incorporation of baseline data collection in ISS hardware validation flights by conducting a number of workshops and science working group meetings. The science and technical requirements for the Advanced Animal Habitat and the Plant Research Unit were reviewed by external scientists. NASA identified hardware capability priorities during these reviews to facilitate initiation of design and development work and clearly indicate capabilities that will be added as new funding sources are identified.
- NASA co-hosted an ISLSWG workshop with the National Space Development Agency of Japan (NASDA) on the topic “Monitoring and Evolution of Microorganisms in ISS.” Topics included microbial sampling results from MIR, new technologies and methods for identification of microorganisms, molecular evolution and molecular methods of microbial monitoring, current ISS sampling methods and recommendations for improvements, and extremeophiles and implications for microbial populations on ISS.
- NASA conducted a workshop titled, “Technology for Fundamental Space Biology.” Topics included chemical and biological sensors, separation and biofluidics technologies, advanced photonic technologies, and miniaturization issues.

**Source Information**

- “Defective membrane repair in dysferlin-deficient muscular dystrophy,” *Nature*, 423(6936): 168–172. May 8, 2003. Bansal D, Miyake K, Vogel SS, Groh S, Chen CC, Williamson R, McNeil PL, Campbell KP.
- Workshop reports are available at <http://www.mbl.edu/CASSLS/celegans.htm> and <http://spaceresearch.nasa.gov>.
- “Synchrony in human, mouse and bacterial cell cultures—a comparison,” *Cell Cycle*. 2(1): 42–45. January–February 2003. Helmstetter CE, Thornton M, Romero A, Eward LK. Department of Biological Sciences, Florida Institute of Technology, Melbourne, FL.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

**Responsible Enterprise(s),**

**Theme(s)**

Biological and Physical Research Enterprise, BSR

*Note: APGs 3B8 and 3H13 are included under both Goal 3 and Goal 4.*

**APG 3B8:** *In close coordination with the research community, allocate flight resources and develop facilities to achieve a balanced and productive research program.*

**Rating: Green**

**Accomplishments**

- NASA completed Phase A definition studies associated with awarding a contract to manage ISS utilization to a Non-Government Organization (NGO) to the International Space Station Research Institute.
- NASA coordinated and participated with the scientific community to define ISS research by developing the Biological and Physical Research Enterprise (BPRE) research plan, detailed research roadmaps, and development of BPRE Strategies. The research plan presents the mission, past accomplishments, priorities, and the intended direction for scientific investigations. NASA also coordinated an open competitive research announcement process.
- NASA implemented a cross-discipline approach to providing balanced resource allocations and flight opportunities on the Russian Soyuz and Progress launch systems as reflected in the ISS Partner Utilization Plan. All facility development is continuing toward established Flight Hardware Availability dates to insure readiness of BPRE equipment as we return to flight.

- NASA deployed ISS research facilities on-orbit consistent with budget constraints and BPRE prioritization, utilizing six racks: Human Research Facility (HRF)-1, Microgravity Science Glovebox (MSG), and the Expedite the Processing of Experiments to the Space Station (EXPRESS) Racks 1, 2, 3A, and 4.

**Source Information**

- Data for this APG is available at <http://www.spaceresearch.nasa.gov> and [http://spaceresearch.nasa.gov/general\\_info/adv.html#ah](http://spaceresearch.nasa.gov/general_info/adv.html#ah).

**Responsible Enterprise(s),**

**Theme(s)**

Biological and Physical Research Enterprise, BSR, PSR, RPFS

*This APG also applies to Objective 4.2.*

**APG 3H13:** *Successfully complete 90% of International Space Station planned mission objectives. Achieve 90% on-orbit mission success for planned International Space Station assembly and logistics activities on the Space Shuttle flights scheduled for FY 2003. Sum total of the successfully accomplished primary mission objectives divided by the total number of mission objectives per year.*

**Rating: Yellow**

**Accomplishments**

- NASA failed to meet this APG, although progress was significant.
- NASA completed two of the five planned Shuttle assembly and logistics missions to ISS prior to the *Columbia* accident. Progress and Soyuz flights continued, and hardware development, testing and certification continued on schedule. Software upgrades to the ISS vehicle continued on schedule. Assembly and logistics flights will resume upon Shuttle return to flight.
  - NASA successfully completed on-line testing of the second of the two racks for the HRF and integrated it into the Multi-Purpose Logistics Module.
  - NASA completed stand-alone testing of the qualification rack for the Habitat Holding Rack, awaiting launch on ULF-1.
  - NASA completed Phase 1 of integrated qualification tests with the incubator and Phase 2 has begun.
  - NASA held the Critical Design Review (CDR) for the Fluids Integrated Rack (FIR).
  - NASA completed verification and test review for the Combustion Integrated Rack (CIR).
  - NASA successfully completed numerous tests including: CIR/Multi-User Droplet Combustion Apparatus (rack insert) integrated testing; FIR vibration and acoustics testing; and facility radiation and portable fire extinguisher testing.
  - NASA completed Experiment Carrier Interface Verification Unit testing and the Master Controller combined components interface test.
  - NASA completed cryogenic testing of all flight Super-Conducting Quantum Interface Device (SQUID) sensors.
  - NASA held the payload interface unit acceptance review at KSC.
  - NASA completed first flight “belly weld” of the helium dewar.

**Source Information**

- Data for this APG is available at [http://brp.arc.nasa.gov/GBL/hld\\_rcks.html](http://brp.arc.nasa.gov/GBL/hld_rcks.html).
- <http://hrf.jsc.nasa.gov/rack2.htm>.

**Responsible Enterprise(s),**

**Theme(s)**

Space Flight Enterprise, ISS, Biological and Physical Research Enterprise, BSR, PSR

**Objective 4.2 Expand understanding of fundamental physical processes and insight into the laws of nature through space-based investigation.**

**APG 3B3:** *Earn external review rating of “green” or “blue” by making progress in the following research focus areas as described in the associated indicators: advance the scientific understanding of complex biological and physical systems.*

**Rating: Green**

**Accomplishments** NASA achieved this APG, as assessed by the Biological and Physical Research Advisory Committee’s external review.

- ① NASA maintained a peer-reviewed research program in Complex Systems physics and chemistry.
  - a. NASA increased colloid physics PI opportunities by 67 percent using existing dynamic light scattering instrument for new missions.
  - b. NASA completed research announcement selections on schedule and is now selecting PI’s for ground-based research on liquid crystals, emulsions, and other emerging areas.
  - c. NASA held a workshop at the American Physical Society annual meeting to identify technology needs and priorities for future space research.
- ② Analyzed ISS flight experiments results in colloidal physics.
  - a. NASA continued completion of data analysis for Physics of Colloids in Space experiment.
  - b. NASA successfully completed the Investigating the Structure of Paramagnetic Aggregates from Colloidal Emulsions (InSpace) experiment on the dynamics of magnetorheological fluids.

**Source Information**

- <http://microgravity.grc.nasa.gov/6712/comflu/complex.html>.
- [http://research.hq.nasa.gov/code\\_u/nra/current/NRA-01-OBPR-08-D/winners.html](http://research.hq.nasa.gov/code_u/nra/current/NRA-01-OBPR-08-D/winners.html).
- <http://ncmr04610.cwru.edu/events/sccm/report.pdf>.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

**Responsible Enterprise(s),**

**Theme(s)** Biological and Physical Research Enterprise, BSR, PSR

**APG 3B5:** *Earn external review rating of “green” or “blue” by making progress in the following research focus area: investigate fundamental and unresolved issues in condensed matter physics and atomic physics, and carry out atomic clock development for space-based utilization.*

**Rating: Green**

**Accomplishments** NASA achieved this APG, as assessed by the Biological and Physical Research Advisory Committee’s external review.

- NASA maintained an outstanding, peer-reviewed research program in condensed matter physics, Bose-Einstein Condensation, and atomic clocks development for space-based utilization.
  - a. NASA selected new fundamental physics research awards on schedule, including Ultraslow and Stopped Light in Microgravity, and concept development for potential flight experiments testing for non-gravitational mass-mass interactions predicted by some unified field models.
  - b. The first atomic clock for ISS research remains on schedule.
- NASA produced scientific discoveries in atomic and condensed matter physics and published in mainstream, peer-reviewed archival journals.

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**Source Information**

- [http://research.hq.nasa.gov/code\\_u/nra/current/NRA-01-OBPR-08-E/winners.html](http://research.hq.nasa.gov/code_u/nra/current/NRA-01-OBPR-08-E/winners.html).
- <http://funphysics.jpl.nasa.gov/technical/technical.html>.
- <http://atomcool.rice.edu/publications.htm>.
- “Amplification of Local Instabilities in a Bose-Einstein Condensate with Attractive Interactions,” *Physical Review Letters*. J.K. Chin, J.M. Vogels, and W. Ketterle, 2003.

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**Responsible Enterprise(s),****Theme(s)**

Biological and Physical Research Enterprise, BSR, PSR

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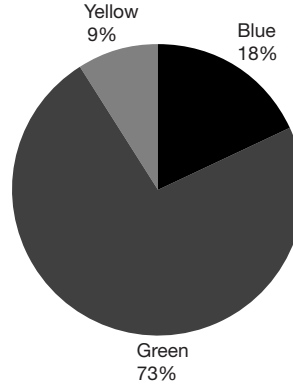
*APGs that apply to this Objective also are reported in:*

*APG 3B8 under Objective 4.1.*



**Goal 5:** Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.

In FY 2003, NASA achieved or exceeded ten of 11 annual performance goals (APGs) under Goal 5. Significant strides in the other APG resulted in a "yellow" rating.



**Objective 5.1 Learn how the solar system originated and evolved to its current diverse state.**

**APG 3S3:** Earn external review rating of "green" on average, on making progress in the following research focus areas: Observe the formation of galaxies and determine the role of gravity in this process; Establish how the evolution of a galaxy and the lifecycle of stars influence the chemical composition of material available for making stars, planets, and living organisms; Observe the formation of planetary systems [outside our solar system] and characterize their properties; Use the exotic space environments within our solar system as natural science laboratories and cross the outer boundary of the solar system to explore the nearby environment of our galaxy. [This will advance our knowledge of the composition of material between stars from which stars and planets are formed.]

**Rating: Green**

**Accomplishments**

NASA achieved this APG, as assessed by the Space Science Advisory Committee's external review.

- NASA's achievements included the following:
  - a. Observations from the Wilkinson Microwave Anisotropy Probe (WMAP) revealed that the first stars were formed much earlier than the oldest galaxies observed so far.
  - b. Using Hubble Space Telescope (HST) measurements to infer that Andromeda, the large galaxy nearest our own Milky Way (and in many ways very similar to it) has much younger stars in its halo with strikingly different chemical compositions from our own galaxy's halo stars.
  - c. Recovering returned data from Voyager-1, in flight since 1977 (and on its way out of our solar system), about the boundary region between the Sun's domain and interstellar space.
- NASA obtained expected data from 100 percent of the operating missions supporting these research areas.

**Source Information**

- The external expert review report is available at <http://spacescience.nasa.gov/adv/minutes/min0308.pdf>.
- Operating mission results are available at <http://spacescience.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

**Responsible Enterprise(s)**

**Theme(s)**

Space Science Enterprise, ASO, SEU, SEC, SSE

*This APG also applies to Objectives 5.7 and 5.8.*

**APG 3S5:** *Earn external review rating of “green,” on average, on making progress in the following research focus areas: Inventory and characterize the remnants of the original material from which the solar system formed. Learn why the planets in our solar system are so different from each other. Learn how the solar system evolves.*

**Rating: Green**

**Accomplishments**

NASA achieved this APG, as assessed by the Space Science Advisory Committee’s external review.

- NASA’s achievements included the following:
  - a. The HST measured the diameter of the remote and icy world, Quaoar, half the size of Pluto and the largest object found in the solar system since the discovery of that planet 72 years ago.
  - b. Mars Global Surveyor and Pathfinder tracking indicate that Mars’ core is at least partially molten.
  - c. Interesting results obtained in NASA-sponsored laboratory, theoretical, and ground-based observations found that components in interplanetary dust particles pre-date the condensation of the solar system.
  - d. An explanation was found for the differences between the inner and outer moons of the larger planets.
  - e. Earth-based radar showed that Titan has rough regions and smooth ones (possibly liquid areas).
  - f. Determining that the puzzlingly low mass of the Kuiper belt may be due to Neptune ejecting many of its original bodies.
  - g. Theoretical work suggested that our solar system was formed in a region of very hot stars, explaining the difference between its giant planets.
- NASA obtained expected data from 100 percent of the operating missions supporting these research areas.

**Source Information**

- The external expert review report is available at <http://spacescience.nasa.gov/adv/minutes/min0308.pdf>.
- Operating mission results are available at <http://spacescience.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

**Responsible Enterprise(s),**

**Theme(s)** Space Science Enterprise, SSE, MEP

*This APG also applies to Objective 5.3*

*Note: APGs 3S9, 3S10, and 3S11 are included under both Goal 1 and Goal 5.*

**APG 3S9:** *Earn external review rating of “green” on making progress in the following area: Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives.*

**Rating: Yellow**

**Accomplishments**

NASA failed to achieve this APG, although progress was significant. NASA achieved six of eight (75%) “major program/project” performance objectives and three of six (50%) applicable objectives for “other projects.” This meets the established threshold of 75 percent for major programs and projects, but does not meet the “majority” threshold for “other projects.”

- Major Programs/Projects progress:
  - a. NASA completed thermal vacuum testing of the Cosmic Origins Spectrograph (COS) one month late in October 2003. The COS will be installed on the fourth Hubble Space Telescope (HST) servicing mission.
  - b. NASA completed the aircraft fuselage structural modification, continuing progress toward telescope installation, for the Stratospheric Observatory for Infrared Astronomy (SOFIA).

- c. The Gravity Probe-B (GP-B) spacecraft, which will test Einstein's general theory of relativity, was not launched due to technical problems uncovered during integrated testing. GP-B is now scheduled for launch in FY 2004.
  - d. NASA launched the twin Mars Exploration Rovers.
  - e. NASA completed Critical Design Review (CDR) for the Mars Reconnaissance Orbiter.
  - f. NASA completed CDR for the Solar Terrestrial Relations Observatory (STEREO) twin spacecraft, which will study solar activity.
  - g. NASA completed CDR for the Gamma-ray Large Area Space Telescope (GLAST), which will yield valuable information about the birth and early evolution of the universe.
  - h. NASA began integration and testing of the Mercury Surface, Space Environment, Geochemistry and Ranging (MESSENGER) spacecraft.
- Other Projects progress:
    - a. Spacecraft integration on the Full-sky Astrometric Mapping Explorer (FAME) was not pursued due to the fact that in FY 2002 the mission was not confirmed to proceed into development.
    - b. NASA completed the payload module for the Coupled Ion-Neutral Dynamics Investigations (CINDI).
    - c. NASA conducted Integration and Test Readiness Review for Deep Impact.
    - d. NASA completed Spectral and Photometric Imaging Receiver Qualification Model Detectors for the Herschel mission.
- Delayed progress in other projects:*
- e. NASA delayed progress on instrument payload module and spacecraft integration for Swift until FY 2004.
  - f. NASA delayed progress on conducting the pre-environmental review for the X-ray Telescope (XRT) Instrument for the Solar-B mission.
  - g. NASA delayed progress on completion of the Cryocooler Qualification Model for the Planck mission.

**Corrective Actions**

- Other Projects
  - a. Swift spacecraft integration was delayed due to correction of improper wiring on the Burst Alert Telescope (BAT) instrument. Integration is now scheduled for November 2003. Changes in quality assurance procedures and personnel assignments have been made to guard against such problems in the future.
  - e. The Japanese space agency, ISAS, slipped the schedule for the Solar-B mission by one year. NASA is supplying components of three instruments and has adjusted schedules accordingly.
  - f. Technical challenges slowed progress on Planck, and the Cryocooler Qualification Model is now scheduled for completion in FY 2004.

**Source Information**

- Program and project schedule reports, and related NASA press releases are available at <http://space.science.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

Responsible Enterprise(s),

Theme(s)

Space Science Enterprise, ASO, MEP, SEC, SEU, SSE

*This APG also applies to Objectives 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, and 5.12.*

**APG 3S10:** Earn external review rating of "green" on making progress in the following technology development area: Focus (advance) technology development on a well-defined set of performance requirements covering the needs of near-term to mid-term strategic plan missions. **Rating: Green**

**Accomplishments**

NASA achieved this APG by meeting seven of nine (78%) technology development performance objectives. (The indicator for the goal was to meet no fewer than 66 percent of the following objectives.)

- NASA completed and documented final analysis of the Advanced Mirror System for the James Webb Space Telescope (formerly Next Generation Space Telescope), the follow-on mission to the HST.
- The previously planned task for the StarLight mission was not pursued due to the fact that the flight demonstration was terminated in FY 2002; however, the effort continues as ground-based technology development in support of formation-flying interferometry under the umbrella of the Terrestrial Planet Finder project.
- NASA completed Phase 1 X-2000 hardware.
- NASA selected Phase II awards for electric propulsion technology development (in late FY 2002, earlier than anticipated) for the In-Space Propulsion mission for electric propulsion technology development.
- NASA completed Phase A studies for the Mars 2007 Scout mission with the selection of Phoenix, which will study the planet's polar ice cap.
- NASA completed the award of the Future Solar Terrestrial Probes instrument contract with the selection of two Phase A studies for the Magnetospheric Multiscale instrument.
- NASA completed the Initial Confirmation Review (Phase A to Phase B transition) for the Solar Dynamics Observatory, which will advance our understanding of the Sun's influence on Earth.
- NASA completed the Spectroscopy X-ray Telescope (SXT) Optics Engineering Unit as part of the Constellation-X Project, but testing was delayed due to problems with the ground support equipment.
- NASA completed an initial Phase A study with the issuance of its Technology Readiness Implementation Report for the Laser Interferometer Space Antenna (LISA) mission, which is dedicated to the search for gravitational waves.

**Source Information** • Program and project schedule reports, and related NASA press releases are available at <http://space.science.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

**Responsible Enterprise(s),**

**Theme(s)** Space Science Enterprise, ASO, MEP, SEC, SEU, SSE

*This APG also applies to Objectives 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, and 5.12.*

**APG 3S11:** *Earn external review rating of "green" on making progress in the following technology validation area: Formulate and implement cost-effective space demonstrations of selected technologies on suitable carriers.*

**Rating: Green**

**Accomplishments** NASA achieved this APG by meeting two of three (67%) of the following flight validation performance objectives:

- NASA successfully completed CDRs for the Space Technology (ST) -6 Autonomous Sciencecraft Experiment and Inertial Stellar Compass.
- NASA successfully completed the Confirmation Review for the ST-7 Disturbance Reduction System Flight Validation/New Millennium Program allowing the project to proceed with implementation.
- Completion of the ST-8 initial confirmation was delayed until FY 2004 due to an earlier delay in the release of the ST-8 NASA research announcement.

**Source Information** • Program and project schedule reports, and related NASA press releases are available at <http://space.science.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

**Responsible Enterprise(s),**

**Theme(s)** Space Science Enterprise, ASO, MEP, SEC, SEU, SSE

*This APG also applies to Objectives 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, and 5.12.*

**Objective 5.2 Understand how life begins and evolves and determine the characteristics of the solar system that led to the origin of life.**

**APG 3S6:** Earn external review rating of “green,” on average, on making progress in the following research focus areas: Investigate the origin and early evolution of life on Earth, and explore the limits of life in terrestrial environments that might provide analogues for conditions on other worlds. Determine the general principles governing the organization of matter into living systems and the conditions required for the emergence and maintenance of life. Chart the distribution of life-sustaining environments within our Solar System, and search for evidence of past and present life. Identify plausible signatures of life on other worlds.

**Rating: Green**

**Accomplishments** NASA achieved this APG, as assessed by the Space Science Advisory Committee’s external review.

- NASA’s achievements included the following:
  - a. Mars Global Surveyor observed very complex drainage areas on Mars that suggest running water and perhaps even precipitation in the past.
  - b. NASA discovered microbes living in very salty water beneath nineteen meters of ice in Antarctica, similar to conditions that might exist on Mars or Europa.
  - c. NASA discovered that terrestrial microbial mats, thought to have dominated much of Earth’s history, produce copious sulfur-containing gases, may be good atmospheric indicators of life on other planets.
  - d. NASA-funded researchers obtained results on RNA including: discovery of an RNA molecule that can catalyze formation of a copy of itself (like DNA does), and the creation of a simple RNA molecule made up of only two bases (instead of the four that modern organisms use).
- NASA obtained expected data from 100 percent of the operating missions supporting these research areas.

**Source Information**

- The external expert review report is available at <http://spacescience.nasa.gov/adv/minutes/min0308.pdf>.
- Operating mission results are available at <http://spacescience.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

**Responsible Enterprise(s), Theme(s)** Space Science Enterprise, SSE, ASO, MEP

*This APG also applies to Objectives 5.4 and 5.9.*

*APGs that apply to this Objective also are reported in: APGs 3S9, 3S10, and 3S11 under Objective 5.1.*

**Objective 5.3 Understand the current state and evolution of the atmosphere, surface, and interior of Mars.**

*APGs that apply to this Objective also are reported in: APG 3S5, 3S9, 3S10, and 3S11 under Objective 5.1.*

**Objective 5.4 Determine if life exists or has ever existed on Mars.**

*APGs that apply to this Objective also are reported in: APG 3S6 under Objective 5.2; and APGs 3S9, 3S10, and 3S11 under Objective 5.1.*

**Objective 5.5 Develop an understanding of Mars in support of possible future human exploration.**

*Note: APGs 3S8 and 3S7 are included under both Goal 1 and Goal 5.*

**APG 3S8:** *Earn external review rating of “green,” on average, on making progress in the following research focus areas: Understand forces and processes, such as impacts, that affect habitability of Earth. Develop the capability to predict space weather. Find extraterrestrial resources and assess the suitability of Solar System locales for future human exploration.* **Rating: Green**

**Accomplishments** NASA achieved this APG, as assessed by the Space Science Advisory Committee’s external review.

- NASA-funded searches are believed to have now found over half of the existing dangerous 1+ kilometer near-Earth objects, and observations of binary asteroids have indicated that most asteroids are like rubble piles, not solid objects.
- Relevant to space weather, researchers developed the first complete model for a coronal mass ejection shock, the acceleration of particles, and transport of the particles to Earth.
- Mars Odyssey data show that the upper meter of some areas of Mars is dominated by ice, which is very important for possible future human exploration.
- NASA obtained expected data from 100 percent of the operating missions supporting these research areas.

**Source Information**

- A report of the external expert review is available at <http://spacescience.nasa.gov/adv/minutes/min0308.pdf>.
- Operating mission results are available at <http://spacescience.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

**Responsible Enterprise(s), Theme(s)** Space Science Enterprise, SEC, SSE, MEP

*APGs that apply to this Objective also are reported in: APGs 3S9, 3S10, and 3S11 under Objective 5.1.*

**Objective 5.6 Understand the changing flow of energy and matter throughout the Sun, heliosphere, and planetary environments.**

**APG 3S7:** *Earn external review rating of “green,” on average, on making progress in the following research focus areas: Understand the origins of long- and short-term solar variability. Understand the effects of solar variability on the solar atmosphere and heliosphere. Understand the space environment of Earth and other planets.* **Rating: Green**

**Accomplishments** NASA achieved this APG, as assessed by the Space Science Advisory Committee’s external review.

- NASA combined information from the Ramaty High Energy Solar Spectroscopic Imager (RHESSI), the Transition Region and Coronal Explorer (TRACE), and the ESA–NASA Solar and Heliospheric Observatory (SOHO) spacecraft and confirmed one theory about high-speed solar eruptions: energy is stored in the low solar corona by magnetic confinement and is abruptly released through reconnection.
- A sounding rocket instrument observed fine structure less than 100 kilometers across in the extreme ultraviolet, shrinking the upper limit for the Sun’s magnetic “building blocks.”
- Data from the Thermosphere, Ionosphere, Mesosphere, Energetics and Dynamics (TIMED) spacecraft showed that greatly increased radiation from a minor constituent, nitric oxide, helps cool the upper atmosphere back to normal temperatures after the increased energy is deposited into Earth’s upper atmosphere by solar activity (which



should make it much hotter than normal).

- NASA obtained expected data from 100 percent of the operating missions supporting these research areas.

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**Source Information**

- A report of the external expert review is available at <http://spacescience.nasa.gov/adv/minutes/min0308.pdf>.
- Operating mission results are available at <http://spacescience.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

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**Responsible Enterprise(s),**

**Theme(s)** Space Science Enterprise, SEC

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APGs that apply to this Objective also are reported in:

APGs 3S9, 3S10, and 3S11 under Objective 5.1.

### **Objective 5.7 Understand the fundamental physical processes of space plasma systems.**

APGs that apply to this Objective also are reported in:

APG 3S3, 3S9, 3S10, and 3S11 under Objective 5.1.

### **Objective 5.8 Learn how galaxies, stars, and planetary systems form and evolve.**

**APG 3S2:** *Earn external review rating of “green,” on average, on making progress in the following research focus areas: Discover the sources of gamma ray bursts and high energy cosmic rays [two phenomena that astronomers believe are created are the most energetic events in the universe]. Test the general theory of relativity near black holes and in the early universe, and search for new physical laws, using the universe as a laboratory. Reveal the nature of cosmic jets and relativistic flows. [Understand the physical mechanisms that can accelerate matter to near the speed of light, as observed in cosmic jets and other relativistic flows.]*

**Rating: Green**

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**Accomplishments**

NASA achieved this APG, as assessed by the Space Science Advisory Committee’s external review.

- NASA made significant progress in understanding gamma ray bursts. Using data from The High Energy Transient Explorer (HETE-2), RHESSI, and Compton Gamma Ray Observatory (CGRO), positive evidence was obtained in support of the collapsar model of bursts, the presence of very strong magnetic fields in powering bursts, a difference between the causes of short and long duration bursts.

- NASA used data from Chandra and the ESA XMM-Newton to gain insight into the behavior of jets from stellar black holes and the role of supermassive black holes in governing the structure and evolution of galaxies.

- NASA obtained expected data from 100 percent of the operating missions supporting these research areas.

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**Source Information**

- A report of the external expert review is available at <http://spacescience.nasa.gov/adv/minutes/min0308.pdf>.
- Operating mission results are available at <http://spacescience.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

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**Responsible Enterprise(s),**

**Theme(s)** Space Science Enterprise, SEU, ASO

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This APG also applies to Objectives 5.11 and 5.12.

**APG 3S4:** Earn external review rating of “green” on average, on making progress in the following research focus areas: Discover planetary systems of other stars [beyond our solar system] and their physical [and chemical] characteristics. Search for worlds that could or do harbor life.

**Rating: Blue**

**Accomplishments**

- NASA significantly exceeded this APG, as assessed by the Space Science Advisory Committee’s external review.
- HST observations advanced our understanding of other planetary systems by enabling a more precise measurement of the mass of a planet outside our solar system and capturing for the first time evidence of a star evaporating the atmosphere of its giant planet.
  - NASA discovered a Jupiter-like planet around a star only 41 light years from Earth, suggesting that Jupiter’s role of reducing the impact threat to smaller planets in our own solar system (e.g., Earth) could be replicated elsewhere.
  - NASA-supported modeling of planet formation led to the expectation of extreme diversity among planets around other stars.
  - NASA obtained expected data from 100 percent of the operating missions supporting these research areas.

**Source Information**

- A report of the external expert review is available at <http://spacescience.nasa.gov/adv/minutes/min0308.pdf>.
- Operating mission results are available at <http://spacescience.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

**Responsible Enterprise(s),**

**Theme(s)**

Space Science Enterprise, ASO

*This APG also applies to Objective 5.9.*

*APGs that apply to this Objective also are reported in: APG 3S3, 3S9, 3S10, and 3S11 under Objective 5.1.*

**Objective 5.9 Understand the diversity of worlds beyond our solar system and search for those that might harbor life.**

*APGs that apply to this Objective also are reported in: APG 3S4 under Objective 5.8; APG 3S6 under Objective 5.2; and APGs 3S9, 3S10, and 3S11 under Objective 5.1.*

**Objective 5.10 Discover what powered the Big Bang and the nature of the mysterious dark energy that is pulling the universe apart.**

**APG 3S1:** Earn external review rating of “green,” on average, on making progress in the following research focus areas: Identify dark matter [the matter in the universe that can be inferred but not directly seen using today’s astronomical techniques] and learn how it shapes galaxies and systems of galaxies. Determine the size, shape, age, and energy content of the universe.

**Rating: Blue**

**Accomplishments**

- NASA significantly exceeded this APG, as assessed by the Space Science Advisory Committee’s external review.
- NASA-sponsored investigations used WMAP data to obtain a precise measurement of the age of the universe and relative amounts of matter, dark matter, and dark energy.
  - NASA-sponsored investigations used data from Far Ultraviolet Spectroscopic Explorer (FUSE), Chandra, Galaxy Evolution Explorer (GALEX), and HST to advance our understanding in many areas, including: nature of dark matter; role of dark matter in the distribution of galaxies; and causes of star formation.

- Obtained expected data from 100 percent of the operating missions supporting these research areas.

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**Source Information**

- A report of the external expert review is available at <http://spacescience.nasa.gov/adv/minutes/min0308.pdf>.
- Operating mission results are available at <http://spacescience.nasa.gov/admin/pubs/03PerfRptSchedules.pdf>.

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**Responsible Enterprise(s),****Theme(s)** Space Science Enterprise, SEU

*This APG also applies to Objective 5.12.*

*APGs that apply to this Objective also are reported in:*

*APGs 3S9, 3S10, and 3S11 under Objective 5.1.*

**Objective 5.11 Learn what happens to space, time, and matter at the edge of a black hole.**

*APGs that apply to this Objective also are reported in:*

*APG 3S2 under Objective 5.8; and*

*APGs 3S9, 3S10, and 3S11 under Objective 5.1.*

**Objective 5.12 Understand the development of structure and the cycles of matter and energy in the evolving universe.**

*APGs that apply to this Objective also are reported in:*

*APG 3S1 under Objective 5.10;*

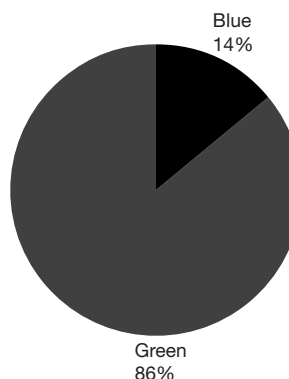
*APG 3S2 under Objective 5.8; and*

*APGs 3S9, 3S10, and 3S11 under Objective 5.1.*

## Mission III: To Inspire the Next Generation of Explorers

**Goal 6:** Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

*In FY 2003, NASA achieved seven of seven annual performance goals (APGs) under Goal 6. One APG was exceeded significantly and received a "blue" rating.*



### Objective 6.1 Increase the number of elementary and secondary students and teachers who are involved in NASA-related education opportunities.

*Note: APGs 3Y25 and 3S12 are included under both Goal 6 and Goal 7.*

**APG 3Y25:** Share the excitement of NASA's scientific discoveries and the practical benefits of Earth science to the public in promoting understanding of science and technology in service to the society. Success will equate to meeting 3 of 4 performance indicators.

**Rating: Green**

#### Accomplishments

NASA achieved this APG by meeting four of four performance indicators.

- 1 NASA sponsored 19 universities, colleges, and institutions of higher education through the Earth System Science Education Alliance to provide three online courses to: engage faculty and scientists in the development of Earth system science courses, curricula, and degree programs in science, liberal arts, and education; promote understanding of Earth system science; encourage communication and cooperation among teachers; and facilitate the use of exceptional classroom materials.
- 2 NASA developed content guidelines for the professional practice of Earth remote sensing and geospatial data by partnering with the American Society for Photogrammetry and Remote Sensing and the University of Mississippi to develop an online curriculum for remote sensing through the Workforce Development Education and Training program.
- 3 NASA provided several stories per month on scientific discoveries, practical benefits and/or new technologies sponsored by NASA's Earth science program to 39 90-second radio programs highlighting NASA Earth System scientists and their research. The radio programs aired through the syndicated *Earth & Sky* radio series, broadcast internationally on Voice of America, American Forces Radio, World Radio Network, and Radio for Peace International. In addition, NASA's Earth Observatory is a freely accessible publication on the Internet where the public can obtain new satellite imagery and scientific information about our home planet, especially Earth's climate and environmental change.
- 4 NASA continued to train a pool of highly qualified scientists and educators in Earth science and remote sensing through the Earth System Science Fellowship Program and the New Investigator Program in Earth Science. The goal was to award approximately 140 graduate fellowships and approximately 25-30 New Investigator awards to recent Ph.D. recipients. In FY 2003, the programs awarded 153 graduate fellowships and 41 early-career awards to interdisciplinary scientists and engineers.

#### Source Information

- The Earth System Science Education Alliance is available at <http://www.cet.edu/essea/>.
- Information on the Workforce Development Education and Training program is available at <http://geoworkforce.olemiss.edu/>.

- The *Earth & Sky* radio Series is available at <http://www.earthsky.com/Shows/NASA/index.html>.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

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**Responsible Enterprise(s),**

**Theme(s)**

Earth Science Enterprise, ESS, Education Enterprise, ED

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**APG 3S12:** *Earn external review rating of “green,” on average, on making progress in the following focus areas: Incorporate a substantial, funded education and outreach program into every space science flight mission and research program; Increase the fraction of the space science community that contributes to a broad public understanding of science and is directly involved in education at the pre-college level; Establish strong and lasting partnerships between the space science and education communities; Develop a national network to identify high-leverage education and outreach opportunities and to support long-term partnerships; Provide ready access to the products of space science education and outreach programs; Promote the participation of underserved and underutilized groups in the space science program by providing new opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs; and Develop tools for evaluating the quality and impact of space science education and outreach programs.*

**Rating: Green**

**Accomplishments**

NASA achieved this APG.

- NASA conducted more than 5,000 NASA-supported Space Science Education and Public Outreach (E/PO) activities events in all 50 states, the District of Columbia, and Puerto Rico—a more than 40 percent increase over the number of events conducted in FY 2002.
  - 1,260 NASA-affiliated space scientists, technologists, and support staff directly participated in space science E/PO activities in FY 2003—a more than 20 percent increase over the number who participated in FY 2002.
  - NASA supported more than 20 significant projects at minority universities, including 15 minority universities that were developing academic and/or research capabilities in space science under the Minority University and College and Education and Research Initiative (MUCERPI) in Space Science.
  - Provided a major space science presence at more than 20 national and 50 regional E/PO conferences, including ten national and 35 regional meetings of science teachers and four national and three regional meetings of organizations focused on minority participation in science.
  - More than ten NASA Space Science-sponsored exhibits or planetarium shows were on display or on tour at major science museums or planetariums across the country, including the Cosmic Questions and Hubble Space Telescope traveling exhibitions and the Northern Lights and Ringworld planetarium shows.
  - NASA developed and added a new capability to the online Space Science Education Resource Directory for ordering products in multimedia hardcopy forms for the reproduction and distribution of audiovisual and CD-based educational products.
  - The NASA Space Science Advisory Committee’s E/PO Task Force completed a major external review of the accomplishments of the Space Science E/PO program over the past five years. Lesley University continued its external study of the long-term effectiveness and educational impact of the Space Science program.
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**Source Information** • The Office of Space Science Education and Public Outreach Annual Report is available at <http://ossim.hq.nasa.gov/ossepo/>.

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**Responsible Enterprise(s), Theme(s)** Education Enterprise, ED, Space Science Enterprise

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**APG 3R16:** *To contribute toward maintaining a well-prepared workforce pipeline, all Enterprise program activities will establish and implement, or continue implementation of, an education outreach plan that results in an educational product. The product shall be consistent with the NASA Implementation Plan for Education and use program content to demonstrate or enhance the learning objectives.* **Rating: Green**

**Accomplishments** NASA achieved this APG by establishing, implementing, or continuing implementation of, education plans that resulted in education products for all Enterprise program activities.

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**Source Information** • Copies of the signed education program plans are available from the Strategy, Communications and Program Integration Division at NASA Headquarters.

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**Responsible Enterprise(s), Theme(s)** Education Enterprise, ED, Aerospace Technology Enterprise

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**APG 3H23:** *Initiate the development and implementation of a formal and systematic mechanism to integrate HEDS latest research knowledge into the K-12/University classroom environment. Ensure the number of HEDS research projects, which are currently flying or scheduled to fly on the Space Shuttle and International Space Station, will be transferred to and made accessible to the education community. Enhance the formal and informal education programs through research, products, services, and distance learning technologies. Collaborate with other NASA education organizations and the external education community to ensure that HEDS-related educational materials and products are developed and made available to K-12 educators.* **Rating: Green**

**Accomplishments** NASA achieved this APG by integrating research knowledge from several key Human Exploration and Development of Space (HEDS) educational programs into the K-12/University classroom.

- NASA provided educators and students (K-4, 5-8, 9-12) with free weekly articles and lesson activities based on human space flight and aerospace technology content via the NASAexplores Web site. During FY 2003, the NASAexplores Web site logged over 20.2 million hits and over 500,000 unique computer addresses. The NASAexplores team conducted workshops for 188 educators and exhibited at conventions reaching over 20,000 attendees.
- NASA provided HEDS-related subject matter and educational opportunities to students through the Distance Learning Outpost (DLO). DLO products and programs expose students to NASA Science, Technology, Engineering, and Mathematics (STEM) career possibilities and NASA-unique facilities and personnel through 50-minute educational modules that allow students and educators to have a live, interactive experience in the classroom.
- NASA continued to engage students through the Spaceflight and Life Sciences Training Program for undergraduate students interested in learning how to design and conduct biological research and operations in space, and how to assess the environmental impacts of a launch site.
- NASA promoted NASA scientific content and educational materials through the Propulsion Basics Initiative, through which teachers are trained in information and hands-on delivery techniques related to teaching propulsion basics, Newtonian physics, gravity, and scientific methods involving data collection and diagnostic testing.

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<b>Source Information</b>	<ul style="list-style-type: none"> <li>• <a href="http://www.spaceflight.nasa.gov">http://www.spaceflight.nasa.gov</a>.</li> <li>• <a href="http://education.jpl.nasa.gov/resources/index.html">http://education.jpl.nasa.gov/resources/index.html</a>.</li> <li>• NASA-HEDS Program Evaluation, Level III report from the University of Virginia.</li> <li>• Additional sources for this APG are available at <a href="http://www.ifmp.nasa.gov/codeb/library/reports.htm">http://www.ifmp.nasa.gov/codeb/library/reports.htm</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Education Enterprise, ED, Space Flight Enterprise

**APG 3CK4:** *Using NASA's unique resources (mission, people, and facilities) to support educational excellence for all, NASA will support the Nation's education goals by meeting 3 of the 4 indicators for this performance goal.* **Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG by meeting four of four performance indicators.</p> <ol style="list-style-type: none"> <li>1 The NASA education program achieved a customer service rating that exceeded the target of 4.3 on a five point rating scale. The average rating for all programs was 4.64. On specific aspects of the program, participants' ratings were as follows: Program staff, 4.7; Recommendation, 4.66; Apply what was learned, 4.51; Valuable experience, 4.64; and Inspiring, 4.56.</li> <li>2 NASA engaged and involved 5.2 million participants in NASA education programs. Of these, 1.4 million were participants in NASA education programs and 3.8 million were participants at NASA conferences, science centers, and other venues.</li> <li>3 NASA increased the amount of education funding for Minority Universities to \$83 million, including \$49 million allocated to Historically Black Colleges and Universities and \$34 million allocated to Other Minority Institutions.</li> <li>4 NASA increased the number of refereed publications by Investigators and the number of research papers and presentations by students at Minority Universities. Principal Investigators (PIs) at minority institutions developed 577 peer reviewed research publications of which 270 included at least one student author. These PIs also delivered 1,131 research presentations, 653 of which included at least one student presenter.</li> </ol>
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<b>Source Information</b>	<ul style="list-style-type: none"> <li>• <a href="http://www.education.nasa.gov">http://www.education.nasa.gov</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Education Enterprise, ED

**Objective 6.2 Support higher education research capability and opportunities that attract and prepare increasing numbers of students and faculty for NASA-related careers.**

**APG 3H24:** *Engage and collaborate with research universities (1) for joint generation of new knowledge in HEDS related areas, (2) for the advancement of the HEDS mission and development of cutting edge technical capabilities, and (3) for ensuring a high quality future workforce. Track the number of collaborative partnerships with research universities. Develop, utilize, and disseminate science, mathematics, and technology instructional materials based on HEDS unique missions and results, and to support the development of higher education curricula. Increase the number of opportunities for teachers and students to enhance their knowledge of HEDS and science, mathematics, technology, engineering and to enhance their skills through mechanisms such as internships, professional development workshops, and research opportunities.* **Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG.</p> <ul style="list-style-type: none"> <li>■ NASA collaborated with research universities to improve the capacity of educational institutions to provide for the Nation's future science and technology workforce requirements through award winning programs such as The KC-135 Student Flight Program. Data showed that 50 percent of all students involved in the KC-135 Student Flight program</li> </ul>
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would join NASA if they were offered jobs. NASA records also indicate that program participants establish careers in NASA-related disciplines, go on to participate in other NASA programs, or become NASA civil servants or contractors. This program began as a way to interest students in science and technology, but it has been adopted by top engineering and science curricula in the Nation. Using the KC-135 Program as a template, Purdue has developed a course called Microgravity Studies which is designed to strengthen engineering skills, and the University of Kentucky is developing a graduate curriculum for Kentucky-funded microgravity studies.

- NASA promoted its scientific content and educational materials through the Propulsion Basics Initiative, through which teachers are trained in information and hands-on delivery techniques related to teaching propulsion basics, Newtonian physics, gravity, and scientific methods involving data collection and diagnostic testing.

- The Kennedy Space Center began building on the existing “Enter the Firing Room” Web site to develop a NASA-unique Web program titled, “Engineering Careers at the Launch Complex.” By utilizing the unique NASA Launch Control Center, students will be inspired by the role models provided, the activities they perform, and the real world applications to their academic careers. Teachers will be able to use the data to better explain “what a NASA engineer does.”

<b>Source Information</b>	<ul style="list-style-type: none"> <li>• <a href="http://www.spaceflight.nasa.gov">http://www.spaceflight.nasa.gov</a>.</li> <li>• <a href="http://nasaexplores.com">http://nasaexplores.com</a>.</li> <li>• <a href="http://education.jsc.nasa.gov/Educators/DLE.htm">http://education.jsc.nasa.gov/Educators/DLE.htm</a>.</li> <li>• Education and outreach managers from NASA's Office of Space Flight at NASA Headquarters.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Education Enterprise, ED, Space Flight Enterprise

**Objective 6.3 Increase the number and diversity of students, teachers, faculty and researchers from underrepresented and underserved communities in NASA related STEM fields.**

**APG 3B11:** *Provide information and educational materials to American teachers.* **Rating: Blue**

<b>Accomplishments</b>	<p>NASA significantly exceeded this APG, as assessed by the Biological and Physical Research Advisory Committee's external review.</p> <ul style="list-style-type: none"> <li>■ NASA developed and distributed electronic and printed educational materials to educational professionals that focused on biological and physical research and distributed these materials for at least three conferences and through the internet.               <ul style="list-style-type: none"> <li>a. NASA reached 70,000 practicing educators through workshops and exhibit participation in nine national educator conferences.</li> <li>b. NASA developed seven educator guides focusing on space research topics that correlate with a standards-based curriculum.</li> <li>c. NASA reached hundreds of university students through pre-service educators workshops.</li> <li>d. NASA provided science-based workshops for the 2003 Explorer Schools workshops.</li> <li>e. NASA provided Office of Biological and Physical Research (OBPR) workshops for NASA Aerospace Educator Specialist training.</li> <li>f. NASA continued ongoing communication with the Life Sciences Educator Network.</li> <li>g. NASA conducted Butterflies and Brassica Educator Workshops (train-the-trainer model).</li> </ul> </li> <li>■ NASA provided students with electronic and printed materials and activities to support their biological and physical research.</li> </ul>
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- a. NASA held the “Dropping in a Microgravity Environment” competition; four teams qualified as finalists.
- b. NASA held the “Orbital Space Settlement” competition, which included entries from Austria, India, Japan, Romania and 12 U.S. states.
- c. NASA held the “Countdown to Launch” event and the STS-107 Student Launch.
- d. NASA developed schematics for building cost effective “educational hardware” supplements for OBPR educator guides to provide students with simulated laboratory tools for conducting space research lessons.
- e. NASA trained undergraduates in the science process through the Spaceflight and Life Sciences Training Program required for preparing an investigation for flight.
- f. NASA distributed copies of “Space Research and You,” a multi-media museum gallery presentation highlighting the science of STS-107, to museums and planetariums.
- g. NASA distributed the NASA Connect program, “Measurement, Ratios, and Graphing: Who Added the ‘Micro’ to Gravity,” through public and cable broadcasting media. This program won a 2003 Regional Emmy in the Children/Youth Category.
- h. NASA reached over 800 people through the first Community Immersion Event, intended to target rural communities by holding community open houses and workshops for pre-service and practicing teachers in Missoula, Montana.

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<b>Source Information</b>	• <a href="http://spaceresearch.nasa.gov">http://spaceresearch.nasa.gov</a> .
<b>Responsible Enterprise(s),</b>	
<b>Theme(s)</b>	Education Enterprise, ED, Biological and Physical Research Enterprise

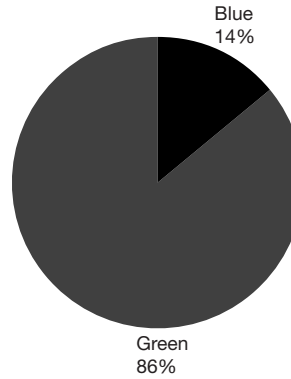
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**Objective 6.4 Increase student, teacher, and public access to NASA education resources via the establishment of e-Education as a principal learning support system.**

No APGs in FY 2003.

**Goal 7:** Engage the public in shaping and sharing the experience of exploration and discovery.

*In FY 2003, NASA achieved seven of seven annual performance goals (APGs) under Goal 7.*



**Objective 7.1 Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.**

*Note: APGs 3Y25 and 3S12 are included under both Goal 6 and Goal 7.*

**APG 3Y25:** *Share the excitement of NASA’s scientific discoveries and the practical benefits of Earth science to the public in promoting understanding of science and technology in service to the society. Success will equate to meeting 3 of 4 performance indicators.* **Rating: Green**

**Accomplishments**

NASA achieved this APG by meeting four of four performance indicators.

- ① NASA sponsored 19 universities, colleges, and institutions of higher education through the Earth System Science Education Alliance to provide three online courses to: engage faculty and scientists in the development of Earth system science courses, curricula and degree programs in science, liberal arts, and education; promote understanding of Earth system science; encourage communication and cooperation among teachers; and facilitate the use of exceptional classroom materials.
- ② NASA developed content guidelines for the professional practice of Earth remote sensing and geospatial data by partnering with the American Society for Photogrammetry and Remote Sensing and the University of Mississippi to develop an online curriculum for remote sensing through the Workforce Development Education and Training program.
- ③ NASA provided several stories per month on scientific discoveries, practical benefits and/or new technologies sponsored by NASA’s Earth science program to 39 90-second radio programs highlighting NASA Earth System scientists and their research. The radio programs aired through the syndicated *Earth & Sky* radio series, broadcast internationally on Voice of America, American Forces Radio, World Radio Network, and Radio for Peace International. In addition, NASA’s Earth Observatory is a freely accessible publication on the Internet where the public can obtain new satellite imagery and scientific information about our home planet, especially Earth’s climate and environmental change.
- ④ NASA continued to train a pool of highly qualified scientists and educators in Earth science and remote sensing through the Earth System Science Fellowship Program and the New Investigator Program in Earth Science. The goal was to award approximately 140 graduate fellowships and approximately 25-30 New Investigator awards to recent Ph.D. recipients. In FY 2003, the programs awarded 153 graduate fellowships and 41 early-career awards to interdisciplinary scientists and engineers.

**Source Information**

- The Earth System Science Education Alliance is available at <http://www.cet.edu/essea/>.
- Information on the Workforce Development Education and Training program is available at <http://geoworkforce.olemiss.edu/>.

- The *Earth & Sky* radio series is available at <http://www.earthsky.com/Shows/NASA/index.html>.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

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**Responsible Enterprise(s),**

**Theme(s)**

Earth Science Enterprise, ESS, Education Enterprise, ED

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**APG 3S12:** *Earn external review rating of “green,” on average, on making progress in the following focus areas: Incorporate a substantial, funded education and outreach program into every space science flight mission and research program; Increase the fraction of the space science community that contributes to a broad public understanding of science and is directly involved in education at the pre-college level; Establish strong and lasting partnerships between the space science and education communities; Develop a national network to identify high-leverage education and outreach opportunities and to support long-term partnerships; Provide ready access to the products of space science education and outreach programs; Promote the participation of underserved and underutilized groups in the space science program by providing new opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs; and Develop tools for evaluating the quality and impact of space science education and outreach programs.*

**Rating: Green**

**Accomplishments**

NASA achieved this APG.

- NASA conducted more than 5,000 NASA-supported Space Science Education and Public Outreach (E/PO) activities events in all 50 states, the District of Columbia, and Puerto Rico—a more than 40 percent increase over the number of events conducted in FY 2002.
  - 1,260 NASA-affiliated space scientists, technologists, and support staff directly participated in space science E/PO activities in FY 2003—a more than 20 percent increase over the number who participated in FY 2002.
  - NASA supported more than 20 significant projects at minority universities, including 15 minority universities that were developing academic and/or research capabilities in space science under the Minority University and College and Education and Research Initiative (MUCERPI) in Space Science.
  - Provided a major space science presence at more than 20 national and 50 regional E/PO conferences, including ten national and 35 regional meetings of science teachers and four national and three regional meetings of organizations focused on minority participation in science.
  - More than ten NASA Space Science-sponsored exhibits or planetarium shows were on display or on tour at major science museums or planetariums across the country, including the Cosmic Questions and Hubble Space Telescope traveling exhibitions and the Northern Lights and Ringworld planetarium shows.
  - NASA developed and added a new capability to the online Space Science Education Resource Directory for ordering products in multimedia hardcopy forms for the reproduction and distribution of audiovisual and CD-based educational products.
  - The NASA Space Science Advisory Committee’s E/PO Task Force completed a major external review of the accomplishments of the Space Science E/PO program over the past five years. Lesley University continued its external study of the long-term effectiveness and educational impact of the Space Science program.
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**Source Information** • The Office of Space Science Education and Public Outreach Annual Report is available at <http://ossim.hq.nasa.gov/ossepo/>.

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**Responsible Enterprise(s), Theme(s)** Education Enterprise, ED, Space Science Enterprise

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**APG 3B12:** *Work with media outlets and public institutions to disseminate Biological and Physical Research Enterprise information to wide audiences.*

**Rating: Green**

**Accomplishments** NASA achieved this APG, as assessed by the Biological and Physical Research Advisory Committee's external review.

- NASA worked with Space Research Museum Network (SRMN, formerly Life Sciences Museum Network) members to explore opportunities to attract and engage public audiences:
  - a. Twenty representatives of the SRMN attended training for use of "Space Research and You," a multi-media, museum gallery presentation.
  - b. Nine SRMN museums invited the public to view the launch of STS-107.
  - c. Space Center Houston teamed with the Bioastronautics Advanced Life Support on a joint project, "The Lunar Growth Chamber."
  - d. NASA provided a working model of the Microgravity Sciences Glovebox for the opening of the traveling exhibit, "International Space Station: The Earth Tour." The exhibit includes hands-on physics activities and a communication loop with simulated ground-controllers to give visitors the opportunity to experience the work conditions experienced by astronauts as they conduct research on orbit.
  - e. NASA launched a two-year national tour that brings space research information to the general public through use of interactive exhibits. The tour, "NASA@Your Library," is a partnership with NASA's Office of Biological and Physical Research (OBPR), the American Library Association, and Apple Computers.
  - f. NASA participated in Space Day 2003 events in partnership with science centers and schools.
  - g. NASA supported major Centennial of Flight Events with exhibits and materials.
  - h. NASA brought current research news to general and science-interested audiences weekly through Science@NASA.gov.
- NASA made information on NASA's Research Partnership Centers (RPC, formerly Commercial Space Centers) and other ongoing research activities available to wide audiences:
  - a. NASA continued to provide a complete view of NASA's Space Product Development (SPD) program from the initial introduction and program goals to successes and links to each of the RPCs through the NASA SPD Office Web site, <http://spd.nasa.gov>.
  - b. NASA continued ongoing dissemination of OBPR research through the Science@NASA Web site.
  - c. NASA featured SPD research via two major media campaigns. The first highlighted the experiments conducted during STS-107 and included a video file, live television and radio interviews with scientists, and news releases with photographs. The BIO2003 conference was the focus of the second media campaign. This campaign included interviews and exhibits at the conference and a media workshop attended by biotechnology reporters including representatives from *U.S. Medicine*, *21st Century Technology*, *The Financial Times*, *Nature Biotechnology*, and United Press International.

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<b>Source Information</b>	<ul style="list-style-type: none"> <li>• <a href="http://spaceresearch.nasa.gov">http://spaceresearch.nasa.gov</a>.</li> <li>• <a href="http://spaceresearch.nasa.gov/news/newsOutreach.html">http://spaceresearch.nasa.gov/news/newsOutreach.html</a>.</li> <li>• <a href="http://spd.nasa.gov/">http://spd.nasa.gov/</a>.</li> </ul>
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<b>Responsible Enterprise(s), Theme(s)</b>	Biological and Physical Research Enterprise, BSR, PSR, RPFS
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**APG 3H21:** *Conduct HEDS related Education and Outreach Programs to improve the engagement/ involvement of the formal education, informal education, and the general public communities. Revise and implement action plans for the Education and Outreach Programs. Continuously evaluate HEDS Education and Outreach Programs and events to provide information about their effectiveness in meeting identified goals.* **Rating: Green**

**Accomplishments** NASA achieved this APG by participating in, sponsoring, or producing thousands of educational and outreach activities, including more than 300 educational conferences, 200 Space Flight Awareness events, 500 exhibits, 700 speaker's bureau engagements, 3,000 astronaut appearances, 30 International Space Station (ISS) downlinks, 800 new education/outreach products, and hundreds of Web site opportunities that engaged the formal and informal education communities as well as the general public all over the world. Traveling exhibits reached millions of people in almost all 50 states, including the ISS Trailers, which visited 21 cities and attracted over 92,000 visitors. The Space Shuttle Launch Experience reached over a half-million people.

<b>Source Information</b>	<ul style="list-style-type: none"> <li>• <a href="http://www.spaceflight.nasa.gov">http://www.spaceflight.nasa.gov</a>.</li> <li>• <a href="http://nasaexplores.com">http://nasaexplores.com</a>.</li> <li>• <a href="http://education.jsc.nasa.gov/Educators/DLE.htm">http://education.jsc.nasa.gov/Educators/DLE.htm</a>.</li> <li>• <a href="http://education.jpl.nasa.gov/resources/index.html">http://education.jpl.nasa.gov/resources/index.html</a>.</li> </ul>
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<b>Responsible Enterprise(s), Theme(s)</b>	Space Flight Enterprise, SFS, SSP, ISS
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**APG 3H22:** *Expand public access to HEDS missions information (especially International Space Station) by working with industry, academia, and the media to create media projects and public engagement initiatives that allow "firsthand" public participation using telepresence for current missions, and virtual reality or mock-ups for future missions beyond Earth orbit.* **Rating: Green**

**Accomplishments** NASA achieved this APG by participating in more than 100 outreach/museum activities, 500 media events, 300 press conferences, 3,000 television live shots, and between April 29 and August 6, 2003, conducted 31 interviews and messages from the ISS. Event examples included interviews with major domestic and international media outlets, NASA Visitor Center welcome messages, educational events with schools and students, and special Agency initiative messages, including those for the Centennial of Flight. Today's live shots/satellite tour with Astronaut Franklin Chang-Diaz reached major Spanish- and English-speaking markets. NASA also developed a seamless education/outreach website presence that generated billions of Web site hits.

<b>Source Information</b>	<ul style="list-style-type: none"> <li>• <a href="http://www.spaceflight.nasa.gov">http://www.spaceflight.nasa.gov</a>.</li> <li>• <a href="http://spaceflight.nasa.gov/station/index.html">http://spaceflight.nasa.gov/station/index.html</a>.</li> <li>• <a href="http://spaceflight.nasa.gov/realdata/tracking/index.html">http://spaceflight.nasa.gov/realdata/tracking/index.html</a>.</li> </ul>
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<b>Responsible Enterprise(s), Theme(s)</b>	Space Flight Enterprise, SFS, SSP, ISS
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**APG 3CK1: Share the experience of expanding the frontiers of air and space with the public and other stakeholders by meeting 4 of the 5 indicators for this goal.**

**Rating: Green**

**Accomplishments**

NASA achieved this APG by meeting four of five performance indicators.

- ① NASA sponsored and provided more than 1,200 educational and media events for the public featuring traveling exhibits showcasing NASA programs, research efforts and technological discoveries, as well as more permanent attractions easily accessible to the public at the visitor centers located at many NASA Centers across the United States.
- ② NASA officials and astronauts conveyed information on NASA activities through the most used media in America—television—through more than 3000 appearances during the year.
- ③ NASA produced for the public 11 new historical publications about NASA's work and achievements, establishing and chronicling the Agency's historical perspective.
- ④ NASA produced/reprinted commercially *The Mission Transcript Collection: U.S. Human Spaceflight Missions from Mercury Redstone 3 to Apollo 17*.

**Source Information**

- *To Reach The High Frontier: A History of U.S. Launch Vehicles*, Roger D. Launius and Dennis R. Jenkins, editors. The University Press of Kentucky, 2002.
- *Looking Backward, Looking Forward: Forty Years of U.S. Human Spaceflight*, Stephen J. Garber, editor. 2002.
- <http://history.nasa.gov>.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

**Responsible NASA**

**Headquarters Office**

NASA History Office

**APG 3CK2: Inform, provide status, enthuse, and explain results, relevance and benefits of NASA's programs by meeting 2 of the 3 indicators for this goal.**

**Rating: Blue**

**Accomplishments**

NASA significantly exceeded this APG.

- ① NASA created over 20 new on-line exhibits on the NASA History Web page including:
  - a. *NASA Office of Defense Affairs: The First Five Years*;
  - b. *Evolution of the Solar System*;
  - c. *The Saturn Illustrated Chronology*;
  - d. *Spacelab: An International Short-Stay Orbiting Laboratory*;
  - e. *NASA Sounding Rockets, 1958-1968: A Historical Summary*;
  - f. *Report of the Apollo 13 Review Board (a.k.a. The Cortright Commission)*;
  - g. *Uplink-Downlink: A History of the Deep Space Network 1957-1997*;
  - h. *The Long Duration Exposure Facility (LDEF): Mission 1 Experiments*;
  - i. *Biomedical Results of Apollo*;
  - j. *What Made Apollo a Success?*;
  - k. *Science in Orbit: The Shuttle & Spacelab Experience: 1981-1986*;
  - l. *Origins of NASA Names*;
  - m. *Flight Research at Ames*;
  - n. *The Planetary Quarantine Program: Origins and Achievements, 1956-1973*;
  - o. *Engineer in Charge: A History of the Langley Aeronautical Laboratory, 1917-1958*;
  - p. *Spaceflight Revolution: NASA Langley Research Center From Sputnik to Apollo*;
  - q. *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program, Volume III: Using Space*;
  - r. *Exploring Space with a Camera*;
  - s. *Aerospace Food Technology*; and
  - t. *The Apollo 16 Flight Journal*.

② NASA's History Office surpassed the standard for timely and effective response to the public by responding to more than 200 monthly email inquiries within seven days 95 percent of the time.

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**Source Information**

- *NASA Office of Defense Affairs: The First Five Years* is available at <http://history.nasa.gov/HHR-32/HHR-32.htm>.
- *Evolution of the Solar System* is available at <http://history.nasa.gov/SP-345/sp345.htm>.
- *The Saturn Illustrated Chronology* is available at <http://history.nasa.gov/MHR-5/cover.htm>.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

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**Responsible NASA**

**Headquarters Office**

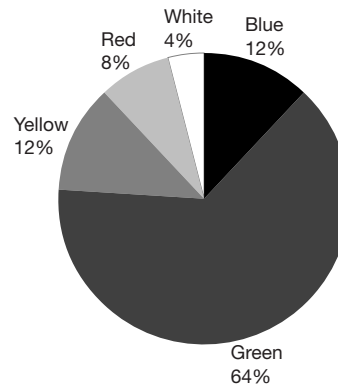
NASA History Office

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## Space Flight Capabilities

**Goal 8:** Ensure the provision of space access, and improve it by increasing safety, reliability, and affordability.

In FY 2003, NASA achieved or exceeded 19 of 25 annual performance goals (APGs) under Goal 8. Three APGs saw significant progress and received a “yellow” rating. In the other three APGs, the goal was either not met, and thus assigned a “red” rating, or postponed by management directive and assigned a “white” rating.



### Objective 8.1 Assure safe, affordable, and reliable U.S.-based crew access and return from the International Space Station.

Note: The budget amendment submitted by the President to Congress on November 13, 2002, cancelled APGs 3R6 to 3R9 and created six APGs under the Space Launch Initiative Theme, labeled 3SLI1 to 3SLI6.

**APG 3SLI1:** *The Orbital Space Plan (OSP) Program Level 1 requirements will be approved by the Agency, establishing the critical top-level specifications that the OSP system must meet.* **Rating: Green**

<b>Accomplishments</b>	NASA achieved this APG. NASA Headquarters' Executive Council approved the OSP Level 1 requirements in January 2003. The Level 1 requirements were extensively reviewed by outside sources as well as across NASA Enterprises. The OSP Program Office placed the requirements under configuration control.
<b>Source Information</b>	<ul style="list-style-type: none"> <li>A summary of OSP Program Level 1 requirements is available at <a href="http://www.slinews.com/ospreq1.html">http://www.slinews.com/ospreq1.html</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Aerospace Technology, SLI

**APG 3SLI2:** *Formal agreements with the International Space Station Program and the Kennedy Space Center Launch Services Provider will be established, ensuring an integrated developmental effort of the Orbital Space Plane system.* **Rating: Green**

<b>Accomplishments</b>	NASA achieved this APG by obtaining signature approval on the following agreements: <ul style="list-style-type: none"> <li>■ The ISS Port Utilization Agreement; and</li> <li>■ The OSP/ISS Interface Definition On-Orbit Hardware Operational Responsibility, Maintenance, Sustaining Engineering and Design Agreement.</li> </ul>
<b>Source Information</b>	<ul style="list-style-type: none"> <li>An executive summary is available at <a href="http://www.ospnews.com/osp_srr.pdf">http://www.ospnews.com/osp_srr.pdf</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Aerospace Technology, SLI

**APG 3SLI3:** *The design of the Demonstration of Autonomous Rendezvous Technology (DART) flight demonstrator will be certified and the verification approach will be approved, completing a key step toward the demonstration of a critical autonomous rendezvous technology for the Orbital Space Plane system.* **Rating: Green**

<b>Accomplishments</b>	NASA achieved this APG when DART successfully completed the Design Certification Review (DCR) on July 31, 2003 and included approval of the verification approach. Results of the
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DCR are documented and available through the DART Project Managers Office at Marshall Space Flight Center. The FY 04 flight demonstration for DART is scheduled for October 18, 2004.

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<b>Source Information</b>	• A summary of minutes from OSP DART Pre-Board Meetings is available at <a href="http://www1.msfc.nasa.gov/NEWSROOM/news/releases/2003/03-145.html">http://www1.msfc.nasa.gov/NEWSROOM/news/releases/2003/03-145.html</a> .
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<b>Responsible Enterprise(s), Theme(s)</b>	Aerospace Technology, SLI
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**Objective 8.2 Improve the safety, affordability and reliability of future space transportation systems.**

**APG 3SLI4:** *An Integrated Technology Plan (ITP) will be developed for the Next Generation Launch Technology Program, establishing the investment strategy to guide future space-transportation investment decisions.* **Rating: Green**

**Accomplishments** NASA achieved this APG with the completion of the Initial Integrated Technology Plan (ITP); a cooperative effort between NASA and DoD organizations. The ITP includes both NASA and DoD technology needs and is now the baseline for defining the technology investment strategies for the National Aerospace Initiative (NAI), as well as the Next Generation Launch Technology (NGLT) Program. The ITP will be reviewed and updated annually.

**Source Information** • A summary is available at <http://www.ngltnews.com/nai.html>.

**Responsible Enterprise(s),  
Theme(s)** Aerospace Technology, SLI

**APG 3SLI5:** *The conceptual design of the Rocket-Based Combined Cycle (RBCC) ground-test engine will be completed, paving the way toward ground demonstration of an air-breathing propulsion system for hypersonic flight.* **Rating: Green**

**Accomplishments** NASA achieved this APG with the Conceptual Design Review (CoDR) of the Rocket-Based Combined Cycle (RBCC)/Integrated Systems Test of an Air-breathing Rocket (ISTAR) ground test engine (GTE). The conceptual design was thoroughly reviewed by a technical team consisting of representatives of MSFC, GRC, LaRC, and the three companies of the RBCC Consortium.

**Source Information** • A summary is available at <http://www.ngltnews.com/istar.html>.

**Responsible Enterprise(s),  
Theme(s)** Aerospace Technology, SLI

**APG 3SLI6:** *Testing of advanced injectors for a hydrocarbon-fueled rocket engine will be performed, demonstrating progress toward development of a million-pound-thrust-class prototype engine.* **Rating: Green**

**Accomplishments** NASA achieved this APG by testing configurations of liquid/liquid preburner injector elements and gas / liquid main chamber injectors in the Single Element Test Rig at the Santa Susana Test Facility in California. Data was used to select the primary and secondary configurations for the RS-84 engine design.

**Source Information** • A results summary is available through the NGLT Program Office at Marshall Space Flight Center.

**Responsible Enterprise(s),  
Theme(s)** Aerospace Technology, SLI

**Objective 8.3 Improve the accessibility of space to better meet research, Space Station assembly, and operations requirements.**

**APG 3H5:** *Assure public, flight crew, and workforce safety for all Space Shuttle operations, measured by the following: Achieve zero type A (damage to property at least \$1M or death) or B (damage to property at least \$250K or disability). Achieve an average of 8 or fewer flight anomalies per Space Shuttle mission.*

**Rating: Red**

**Accomplishments** NASA failed to achieve this APG due to the occurrence of one type A and one type B mishap:

- The type A mishap refers to the STS-107 accident.
- The type B mishap refers to damage to the Remote Manipulator System (i.e., Shuttle's robotic arm) from contact with the platform, which occurred in November 2002. This mishap resulted in \$300,000 worth of damage.
- NASA identified the following flight anomalies for Space Shuttle missions:
  - a. Three in flight anomalies (IFAs) were identified for STS-112 and eight for STS-113.
  - b. Five IFAs were baselined for STS-107. Only three out of six scheduled missions flew in FY 2003.

**Corrective Actions**

- On February 1, 2003, the Space Shuttle *Columbia* and her 7-member crew were lost during reentry. The cause of this accident was foam impacting the Orbiter wing during launch and causing a crack that resulted in the breakup of the vehicle as it returned to Earth. The *Columbia* Accident Investigation Board (CAIB) Report has provided NASA with the roadmap for moving forward with our return to flight efforts. NASA accepts the findings of the CAIB, we will comply with the Board's recommendations, and we embrace the Report and all that is included in it.
- Corrective actions for the type B mishap with the RMS include clarification of roles in payload processing, improved pre-task briefing, and the addition of appropriate warnings on hardware.

**Source Information** NASA's *Implementation Plan for Return to Flight and Beyond* is available at <http://www.nasa.gov/columbia/home/index.html>.

**Responsible Enterprise(s),**

**Theme(s)** Space Flight Enterprise, SSP

**APG 3H6:** *Safely meet the FY 2003 manifest and flight rate commitment. Annual performance goal is measured for Space Shuttle performance only. Achieve 100 percent on-orbit mission success for all flights in FY 2003. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract.*

**Rating: Red**

**Accomplishments** NASA failed to achieve this APG because not all Space Shuttle flights in FY 2003 met the 100 percent on-orbit mission success criteria. STS-112 achieved 101 percent mission success, as all major mission objectives were accomplished and nearly all get-ahead tasks were completed. STS-113 also achieved 101 percent mission success, as all major mission objectives were accomplished and some get-ahead tasks were completed. STS-107 achieved 32 percent of SpaceHab operations, 64 percent for Fast Reaction Experiments Enabling Science, Technology, Applications and Research (FREESTAR) operations, and 100 percent for Extended Duration Orbiter (EDO) pallet operations.

**Corrective Actions** On February 1, 2003, the Space Shuttle *Columbia* and her seven-member crew were lost during reentry. The cause of this accident was foam impacting the Orbiter wing during



launch and causing a crack that resulted in the breakup of the vehicle as it returned to Earth. The *Columbia* Accident Investigation Board (CAIB) Report has provided NASA with the roadmap for moving forward with our return to flight efforts. NASA accepts the findings of the CAIB, we will comply with the Board's recommendations, and we embrace the Report and all that is included in it.

**Source Information**

- Information on mission accomplishments is available at <http://spaceflight.nasa.gov/shuttle/archives/index.html>.
- NASA's *Implementation Plan for Return to Flight and Beyond* is available at <http://www.nasa.gov/columbia/home/index.html>.

**Responsible Enterprise(s), Theme(s)** Space Flight Enterprise, SSP

**APG 3H7:** *Maintain a "12-month" manifest preparation time. Baseline Flight Requirements Document (FRD) tracks achievement of this goal and it defines the primary cargo manifest that uses the "12 month" template. Achievement of performance goal is independent of delays caused by non-manifest related issues, for example payload readiness to launch.* **Rating: Green**

**Accomplishments** NASA achieved this APG for the three Shuttle missions in FY 2003. All three used the 12-month template.

**Source Information**

- The FRD is an internal Space Shuttle program-controlled document. The FRDs for the three FY 2003 Shuttle launches were as follows:

	<i>Initial FRD Signed</i>	<i>Launch Planning Date at FRD</i>
STS-112	5/3/2001	7/11/2002
STS-113	6/29/2001	8/22/2002
STS-107	11/15/1999	1/11/2001

**Responsible Enterprise(s), Theme(s)** Space Flight Enterprise, SFS, SSP

**APG 3H8:** *Have in place a Shuttle safety investment program that ensures the availability of a safe and reliable Shuttle system for International Space Station assembly and operations. Meet the major FY 2003 Space Shuttle Safety Upgrade milestones. For this metric, major milestones are defined to be the Preliminary Design Review dates, Critical Design Review dates, Ready dates for upgrade installation/integration with flight hardware/software, and Ready dates for first flight.* **Rating: Green**

**Accomplishments** NASA achieved this APG by holding Critical Design Reviews (CDR) for flight hardware, displays, and abort monitor flight software. CDRs for Wheel and Pressure Transducer (part of the Tire/Wheel upgrade project) also were held. Initial construction on the Friction Stir Weld began. The Cockpit Avionics Upgrade system CDR was deferred until September.

**Source Information**

- An overview of the Space Shuttle Service Life Extension Program (SLEP) is available under the APG3H8 link at <http://www.hq.nasa.gov/osf/metrics.html>.

**Responsible Enterprise(s), Theme(s)** Space Flight Enterprise, SSP

**APG 3H20:** *NASA will aggressively pursue Space Shuttle competitive sourcing opportunities that improve the Shuttle's safety and operational efficiency. Obtain Administration approval of Space Shuttle competitive sourcing plan and implementation approach. Complete cost benefit analyses of competitive sourcing opportunities by an independent third party. Pursue contract mechanisms for shuttle competitive sourcing which assures maintenance of Shuttle system safety.* **Rating: White**

**Accomplishments** NASA postponed this APG due to the *Columbia* accident. The Space Shuttle Program (SSP) has explored alternatives for sourcing Space Shuttle flight operations following the

Space Flight Operations Contract and is assessing possible courses of action. In addition, we are engaging in dialogue with the current contractor, United Space Alliance, and potential competitors.

<b>Corrective Actions</b>	NASA will resume this activity following consideration of the Report of the <i>Columbia</i> Accident Investigation Board.
<b>Source Information</b>	<ul style="list-style-type: none"> <li>• More information on this data is available through the Office of Space Flight at NASA Headquarters.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Space Flight Enterprise, SSP

**APG 3H25:** *Space Shuttle supports exploration by transporting payloads, logistics, and crew to the International Space Station. Achieve 100 percent on-orbit mission success for all flights in FY 2003. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract.*

**Rating: Yellow**

<b>Accomplishments</b>	NASA failed to achieve this APG, although progress was significant. Only three out of six scheduled missions flew in FY 2003. STS-112 achieved 101 percent mission success due to the accomplishment of all major mission objectives and nearly all get-ahead tasks. STS-113 also achieved 101 percent mission success due to the accomplishment of all major mission objectives and some get-ahead tasks.
<b>Corrective Actions</b>	All Shuttle flights are on hold due to the <i>Columbia</i> accident. Delays and adjustments to the ISS assembly schedule have resulted from not being able to fly five scheduled ISS missions in FY 2003.
<b>Source Information</b>	<ul style="list-style-type: none"> <li>• Information on mission accomplishments is available at <a href="http://spaceflight.nasa.gov/shuttle/archives/index.html">http://spaceflight.nasa.gov/shuttle/archives/index.html</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Space Flight Enterprise, SSP

**Objective 8.4 Assure capabilities for world-class research on a laboratory in low Earth orbit.**

**APG 3H2:** *Provide for science and technology research on the International Space Station a minimum average of five mid-deck lockers for each Space Shuttle mission to the ISS and maintain 80 percent availability of Space Station resources to support science and technology research. Demonstrate that an average of five mid-deck lockers was used to support research for each Space Shuttle mission going to the International Space Station (source International Space Station manifest). Formulate a customer survey that measures customer satisfaction of available Space Station resources to ISS researchers. Determine if adequate resources were available to the science and technology researchers conducting experiments on the International Space Station. Conduct a customer survey of International Space Station researchers at the conclusion of their research on Space Station (80 percent customer satisfaction on available resources = green).*

**Rating: Yellow**

<b>Accomplishments</b>	<p>NASA failed to achieve this APG, although progress was significant.</p> <ul style="list-style-type: none"> <li>■ Through January 2003, an average of seven Shuttle mid-deck locker equivalents were used to support research mission requirements for the ISS. After the <i>Columbia</i> accident, Russian Progress and Soyuz vehicles were used for station resupply and crew rotation. As a result, research upmass (payload weight) was limited to up to 100 kg per flight. This reduction in upmass was directly attributable to the loss of <i>Columbia</i> and was beyond the program's control.</li> </ul>
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■ A customer survey was developed for the ISS. At the time of *Columbia*, the ISS program had begun instituting processes and procedures to further improve customer service to the ISS research community. Despite the effects of *Columbia* on the ISS schedule and research community, the program increased its positive customer satisfaction rating from 60 percent in FY 2002 to 72 percent in FY 2003.

<b>Corrective Actions</b>	Once Shuttle return to flight is achieved, NASA will develop a revised ISS assembly sequence to include new allocations for research payloads. The return to flight of the Space Shuttle will also provide the required upmass and downmass to utilize the full scientific capabilities of the ISS. NASA will continue to conduct customer surveys to gather data and lessons learned for existing research processes.
<b>Source Information</b>	<ul style="list-style-type: none"> <li>Information on mission accomplishments is available at <a href="http://iss-www.jsc.nasa.gov/ss/issapt/payofc/">http://iss-www.jsc.nasa.gov/ss/issapt/payofc/</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Space Flight Enterprise, SSP, ISS

**APG 3H11:** *Demonstrate International Space Station on-orbit vehicle operational safety, reliability, and performance. Zero safety incidents (i.e. no on-orbit injuries) Actual resources available to the payloads measured against the planned payload allocation for power, crew time, and telemetry. (Green = 80 percent or greater).* **Rating: Green**

<b>Accomplishments</b>	NASA achieved this APG by experiencing zero safety incidents involving the crew or visiting vehicles during FY 2003. In addition, 92 percent of power, crew time, and telemetry resources were provided to manifested and flown payloads in FY 2003, significantly exceeding the 80 percent goal.
<b>Source Information</b>	<ul style="list-style-type: none"> <li>The Safety and Mission Assurance on-orbit assessment metric is available under the annual performance goal 3H11 link at <a href="http://www.hq.nasa.gov/osf/metrics.html">http://www.hq.nasa.gov/osf/metrics.html</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Space Flight Enterprise, ISS

**APG 3H12:** *Demonstrate and document the International Space Station program progress and readiness at a level sufficient to show adequate support of the assembly schedule. Conduct monthly status reviews to show maturity and preparation of flight readiness products. Maintaining 80 percent of defined activities are within scheduled targets.* **Rating: Green**

<b>Accomplishments</b>	NASA achieved this APG by completing over 95 percent of flight readiness products within original targets through January 2003. After the Columbia accident, the ISS program deferred some flight readiness products, but most continued development up to the point at which firm Shuttle launch parameters were required. Throughout the remainder of FY 2003, 87 percent of these flight products were completed within scheduled targets.
<b>Source Information</b>	<ul style="list-style-type: none"> <li>A flight-readiness summary for upcoming flights is available under the annual performance goal 3H12 link at <a href="http://www.hq.nasa.gov/osf/metrics.html">http://www.hq.nasa.gov/osf/metrics.html</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Space Flight Enterprise, ISS

**APG 3H15:** *Develop and execute a management plan and open future Station hardware and service procurements to innovation and cost-saving ideas.* **Rating: Green**

<b>Accomplishments</b>	NASA achieved this APG by fully implementing the ISS management plan. A new management structure is in place, with the program manager reporting directly to NASA Headquarters and a new management information system reporting program performance, trends, and monthly assessment results. The program baseline is captured in a cost analysis requirements description, and two independent cost estimates confirmed the credibility of NASA's life cycle cost projection. A new, integrated work breakdown structure
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and corresponding cost breakdown structure are being employed, and program performance and cost risks are being assessed monthly using new performance measurement and early warning systems. Program budget reserves are held by NASA Headquarters to control baseline content and respond to emergent requirements, and a contract strategy for the program's operations phase is being implemented with the first contract awards expected in FY 2004.

**Source Information** • A summary of ISS program performance is available under the annual performance goal 3H15 link at <http://www.hq.nasa.gov/osf/metrics.html>.

**Responsible Enterprise(s), Theme(s)** Space Flight Enterprise, ISS

**Objective 8.5 Provide services for space communications, rocket propulsion testing, and launch in support of NASA, other government agencies and industry.**

**APG 3H3:** *Provide reliable launch services for approved missions. NASA success rate at or above a running average of 95 percent for missions noted on the Flight Planning Board manifest and launched pursuant to commercial launch service contracts.* **Rating: Blue**

**Accomplishments** NASA significantly exceeded this APG by successfully completing all eight NASA-managed Expendable Launch Vehicle launches of primary payloads. This brings the NASA running average to 67 successes out of 68 attempts from FY 1987—a 98.5 percent success rate.

**Source Information** • The flight history of NASA payloads is available at <https://extranet.hq.nasa.gov/elv/IMAGES/lh.pdf>.

**Responsible Enterprise(s), Theme(s)** Space Flight Enterprise, SFS

**APG 3H4:** *Provide reliable space communication services for Space Science and Earth Science missions be consistent with program and project requirements. Achieve at least 95 percent of planned data delivery for space flight missions.* **Rating: Blue**

**Accomplishments** NASA significantly exceeded this APG by delivering greater than 99 percent of planned data as part of the Space Communications Program.

**Source Information** • Monthly program management reviews, including operations metrics reports for space science and Earth science are available through the Office of Space Flight at NASA Headquarters.

**Responsible Enterprise(s), Theme(s)** Space Flight Enterprise, SFS

**APG 3H10:** *HEDS Enterprise will work with the Second Generation Program to define available opportunities to utilize Office of Space Flight assets to test 2nd Generation Reusable Launch Vehicle enabling technologies. HEDS shall: Develop comprehensive list of test environments and associated test specimen size that can be accommodated. Define available window(s) of opportunity. Participate in Second Generation Program technical interchange meetings. Attend quarterly SLI and Space Transportation reviews.* **Rating: Green**

**Accomplishments** NASA achieved this APG by transferring advanced propulsion technology research from the Space Launch Initiative (SLI) program to the NGLT program; and by participating in all NGLT quarterly reviews to update its current Advanced Systems, Technologies, Resources, and Analysis (ASTRA) work breakdown structure and associated roadmaps.

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**Source Information**      • <http://www.ngltnews.com>.  
• <http://hedsadvprograms.nasa.gov>.  
• <http://www.slinews.com/>.

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**Responsible Enterprise(s),  
Theme(s)**                      Space Flight Enterprise, SFS

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**APG 3H14:** *Space Communications performance metrics for each Space Shuttle and International Space Station mission/expedition will be consistent with detailed program and project operations requirements in project Service Level Agreements. Achieve at least 95 percent of planned data delivery for each Space Shuttle mission and International Space Station expedition.*      **Rating: Blue**

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**Accomplishments**              NASA significantly exceeded this APG by delivering greater than 99 percent of planned data as part of the Space Communications Program.

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**Source Information**              • Monthly program management reviews, including operations metrics reports for human spaceflight facilities are available through the Office of Space Flight at NASA Headquarters.

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**Responsible Enterprise(s),  
Theme(s)**                      Space Flight Enterprise, SFS

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**APG 3H16:** *The Space Communications program will conduct tasks that enable commercialization and will minimize investment in government infrastructure for which commercial alternatives are being developed. Increase the percentage of the space operations budget allocated to the acquisition of communications and data services from the commercial sector from 15 percent in FY 2001 and 20 percent in FY 2002 to 25 percent in FY 2003.*      **Rating: Yellow**

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**Accomplishments**              NASA failed to achieve this APG, although progress was significant. Based on contractor-provided reports, the Space Communications Program utilized 22 percent of its Consolidated Space Operations Contract (CSOC) budget for commercialization services not the 25 percent as targeted. NASA increased the ground stations and voice and video teleconferencing commercial services despite the fact that anticipated ground network commercialization in Merritt Island Launch Area (MILA) and Alaska was not realized.

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**Corrective Actions**              This APG was established for the CSOC contract and will be cancelled for next year. The Alaska ground network commercialization initiative will be accomplished in FY 2004.

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**Source Information**              • Center budget documents and from Space Operations Management Office commercialization plan measurements are available through the Office of Space Flight at NASA Headquarters.

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**Responsible Enterprise(s),  
Theme(s)**                      Space Flight Enterprise, SFS

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**APG 3H17:** *Establish mechanisms to enable NASA access to the use of U.S. commercially developed launch systems. Assure that NASA launch service contracts include annual on-ramps for newly developed commercial launch services as they meet NASA's risk mitigation policy.*      **Rating: Green**

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**Accomplishments**              NASA achieved this APG through its active launch service contracts. NASA received and evaluated one proposal for new launch service capabilities under the bi-annual NASA Launch Services on-ramp provision.

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**Source Information**              • The NASA Launch Services contract request for proposals, including on-ramp provisions, is available at <http://www.ksc.nasa.gov/procurement/nls/index.html>.  
• The NASA Acquisitions Internet Service Web site is available at <http://prod.nais.nasa.gov/cgi-bin/nais/index.cgi>.

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**Responsible Enterprise(s),  
Theme(s)**                      Space Flight Enterprise, SFS

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**APG 3H18:** *Establish mechanisms to enable NASA to utilize commercial payload processing facilities. Fifty percent or greater of the Space Shuttle (excluding International Space Station) and ELV (excluding planetary) payloads will be processed utilizing commercial facilities.*

**Rating: Green**

**Accomplishments** NASA achieved this APG by contracting for 24 payloads to be processed (out of a planned 40-mission in flow) utilizing commercial facilities. This resulted in 60 percent of payloads being processed utilizing commercial facilities.

**Source Information**

- Performance data obtained from normal program reporting and procurement documents available through the Office of Space Flight at NASA Headquarters.

**Responsible Enterprise(s),**

**Theme(s)** Space Flight Enterprise, SFS.

**APG 3H19:** *Increase collaboration in space commerce with a variety of industry, academia and non-profit organizations. Materially participate in the development and issuance of a NASA-wide enhanced space commerce strategy document; and produce formal documents that demonstrate serious potential collaboration with at least three private sector companies.*

**Rating: Green**

**Accomplishments** NASA achieved this APG by continuing to refine the nature of partnerships between the Agency and the private sector in order to better align efforts to enable the commercial development of space with those that further the overall NASA mission and vision. Given this focus on public-private partnerships that add value to NASA's programs, the Agency began a thorough review of its previous strategy for the enhancement of space commerce. During this review, NASA continued to support and expand upon cooperative activities between NASA and its industrial, academic, and non-profit partners. Examples include: a) the airing of solicitations through the Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) programs, which allow small businesses the opportunity to compete for advanced technology contracts that will be useful in Government projects, and; b) the continued use of commercial launch services (see APG 3H17 above) and negotiations with potential alternate launch providers such as Kistler Aerospace.

**Source Information**

- NASA's commercial development of space activities and Launch Services contract request for proposals are available at <http://www.commercial.nasa.gov/>.
- <http://sbir.gsfc.nasa.gov/SBIR/SBIR.html>.

**Responsible Enterprise(s),**

**Theme(s)** Space Flight Enterprise, SFS.

## **Objective 8.6 Create concepts, technologies and capabilities for space transportation that enable affordable future infrastructures.**

**APG 3H9:** *HEDS will collaborate with NASA's Office of Human Resources and Education, and Second Generation Program Office to establish and implement an agency wide training program for employees that support the Space Launch Initiative needs. The training program will communicate and document "lessons learned" from other major technology development and operational programs. "Lessons learned" would be based on but not limited to both government and contractor experience on the Space Shuttle program, Saturn program, and other commercial launch vehicle programs.*

**Rating: Green**

**Accomplishments** NASA achieved this APG by developing the NASA Academy of Program and Project Leadership (APPL), a research-based organization that serves project practitioners by providing products and services that manage risk, maximize human capital, contain cost, maintain project schedules, develop high-performance teams, and promote mission success. The APPL program supports the President's Management Agenda by providing



training to the Space Launch Initiative and other program offices in order to develop leaders capable of inspiring, mentoring, and guiding project teams; by improving team performance; and by facilitating Agency-wide sharing of lessons learned and knowledge capture of best practices. The APPL curriculum draws information in the NASA Lessons Learned Information System (LLIS, a database of lessons learned from contributors across NASA and other organizations) and the Corrective Action Tracking System (CATS, used to support the life cycle management of non-conformances and observations).

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**Source Information**

- Information on the APPL training program can be found at <http://appl.nasa.gov/home/>.
- Information on LLIS can be found at <http://llis.nasa.gov/>.

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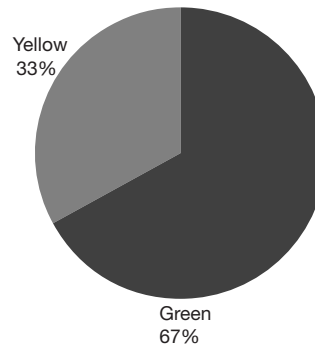
**Responsible Enterprise(s),  
Theme(s)**

Space Flight Enterprise, SFS.

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**Goal 9:** Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.

*In FY 2003, NASA achieved two of three annual performance goals (APGs) under Goal 9. Significant progress in the remaining APG resulted in a “yellow” rating.*



**Objective 9.1 Understand human physiological reactions to reduced gravity and develop countermeasures to assure survival of humans traveling far from Earth.**

**APG 3B1:** Earn external review rating of “green” or “blue” by making progress in the following research focus areas: identify and test biomedical countermeasures that will make space flight safer for humans, and identify and test technologies that will enhance human performance in space flight.

**Rating: Green**

**Accomplishments**

NASA achieved this APG, as assessed by the Biological and Physical Research Advisory Committee’s external review.

- NASA completed an experiment on ISS Increment six to determine whether pulmonary edema occurs in spaceflight. This experiment studied the effect of long-term exposure to microgravity and the effects of Extra Vehicular Activity (EVA) on pulmonary function.
- NASA completed approximately 75 percent of required data (flight activities as of ISS Increment six) for the Kanas-Psychosocial study that will provide knowledge for the improvement of psychological well being of ground and flight crews for ISS. The study characterizes important interpersonal factors that may affect crew performance (such as tension, cohesion, and leadership roles), the relationship between space crews and mission control personnel on Earth, and the influence of cultural and language background on the interpersonal climate during ISS missions.
- NASA maintained a cutting-edge research program in Biomedical Research and Countermeasures and in Advanced Human Support Technology by sponsoring 272 investigations in bioastronautics research. Investigations were selected from investigator-initiated, peer-reviewed solicitations (both ground and flight), National Space Biomedical Research Institute, and the Advanced Human Support Technologies.
- NASA and the Department of Energy completed a construction review of the NASA Space Radiation Laboratory (NSRL) to enable investigators to perform research using heavy ion radiation. (Note: NSRL was formerly named the Brookhaven Booster Application Facility.) Commissioning experiments involving ten principal investigators (PI) began in July 2003. A peer-review process selected 29 individual investigators for the first operational runs.
- Although all data from the in-flight portion of STS-107 Biomedical Experiments was considered lost, reviewed investigations, notified PIs of future actions, and completed closeout activities. Associated ground studies, or partial re-flight of experiments, will be used to complete publishable portions of the experiments.
- NASA gathered data from experiments using the Human Research Facility on ISS. During FY 2003, 11 Biomedical experiments were active on ISS.
- NASA produced and published Biomedical research discoveries in mainstream peer-reviewed archival journals. Bioastronautics Investigators published, on average, six journal articles per month.

■ NASA published three results papers of Bioastronautics experiments conducted during early ISS Increments (1 through 6) in peer-reviewed journals.

<b>Source Information</b>	<ul style="list-style-type: none"> <li>• The Office of Biological and Physical Research Web site, available at <a href="http://spaceresearch.nasa.gov">http://spaceresearch.nasa.gov</a>.</li> <li>• A list of all experiments using the Human Research Facility is available at <a href="http://hrf.jsc.nasa.gov/">http://hrf.jsc.nasa.gov/</a>.</li> <li>• “Effect of short- and long-duration spaceflight on QTc intervals in healthy astronauts,” <i>American Journal of Cardiology</i>, 91(4). February 2003. D’Aunno DS, Dougherty AH, DeBlock HF, Meck JV.</li> <li>• Additional sources for this APG are available at <a href="http://www.ifmp.nasa.gov/codeb/library/reports.htm">http://www.ifmp.nasa.gov/codeb/library/reports.htm</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Biological and Physical Research Enterprise, BSR

**Objective 9.2 Develop new human support systems and solutions to low gravity technological challenges to allow the next generation of explorers to go beyond low Earth orbit.**

**APG 3B2:** *Earn external review rating of “green” or “blue” by making progress in the following research focus area: identify and test new technologies to improve life support systems for spacecraft.* **Rating: Green**

**Accomplishments** NASA achieved this APG, as assessed by the Biological and Physical Research Advisory Committee’s external review by achieving a 40 percent reduction in the projected mass of a life support flight system compared to the system baselined for ISS. Risk mitigation accomplishments for a Sabatier reactor for ISS, including design of a long life compressor and a gas-water separator, along with substantial progress on the Vapor Phase Catalytic Ammonia Removal system, contributed to the reduction.

<b>Source Information</b>	• <a href="http://advlifesupport.jsc.nasa.gov/">http://advlifesupport.jsc.nasa.gov/</a> .
<b>Responsible Enterprise(s), Theme(s)</b>	Biological and Physical Research Enterprise, BSR

**Objective 9.3 Demonstrate the ability to support a permanent human presence in low Earth orbit as a stepping-stone to human presence beyond.**

No APGs allocated to this objective in FY 2003.

**Objective 9.4 Develop innovative concepts for systems, infrastructures and missions to extend the duration and boundaries of human space flight.**

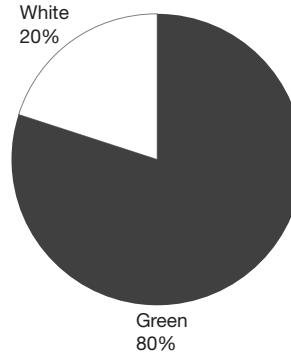
**APG 3H1:** *The HEDS Advanced Programs office works collaboratively with other NASA Enterprises and Field Centers on advanced planning activities to leverage available resources in advanced technologies that will enable safe, effective, and affordable human/robotic exploration. NASA Exploration Team (NEXT) will produce and distribute an annual report documenting advanced planning activities and advanced technology advancement.* **Rating: Yellow**

**Accomplishments** NASA failed to achieve this APG, although progress was significant. NASA is finalizing development of an Integrated Space Plan (ISP) that will address key technology research priorities necessary for future space exploration missions. The ISP will be released in February 2004.

<b>Source Information</b>	• Information on the ISP can be obtained through the Office of Space Flight at NASA Headquarters.
<b>Responsible Enterprise(s), Theme(s)</b>	Space Flight Enterprise, ISS, SFS

**Goal 10:** Enable revolutionary capabilities through new technology.

In FY 2003, NASA achieved four of five annual performance goals (APGs) under Goal 10. Due to management decisions to cancel some programs, one APG was not achieved, and received a "white" rating.



**Objective 10.1 Improve the capability to assess and manage risk in the synthesis of complex engineering systems.**

**APG 3R11:** Complete development of an organizational risk model and establish initial high dependability computing testbeds and tools as defined in the following indicators. **Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG.</p> <ul style="list-style-type: none"> <li>① Process and Concept Innovation: NASA completed an initial organization risk model by collecting data (from observation, surveys, and analysis) from three different NASA organizations and constructing computational models of the organizations.</li> <li>② Validation and Implementation: <ul style="list-style-type: none"> <li>a. The High Dependability Computing Project (HDCP) delivered and demonstrated two high-dependability operational testbeds that serve as analogues to JPL's MARS Mission Data Systems for coordinated flight control and ground operation support software.</li> <li>b. NASA demonstrated certifiable program synthesis technology that enables product-oriented certification, rather than certification for flight, based on traditional methods.</li> </ul> </li> <li>③ Advanced Engineering and Analysis Technologies: NASA validated nonlinear structural analysis tools.</li> </ul>
<b>Source Information</b>	<ul style="list-style-type: none"> <li>• Reports on the organizational risk model work (i.e., program and project milestone reports; literature reviews; ethnographic analysis; computational modeling; survey design; and decision theory/choice capture) can be found in the Engineering for Complex Systems archive available at <a href="http://ecs.arc.nasa.gov/resandarch.html">http://ecs.arc.nasa.gov/resandarch.html</a>.</li> <li>• Information on HDCP's efforts is available at <a href="http://www.hdcp.org/index.html">http://www.hdcp.org/index.html</a> and a list of HDCP-related publications is available at <a href="http://www.hdcp.org/Publications/index.html">http://www.hdcp.org/Publications/index.html</a>.</li> </ul>
<b>Responsible Enterprise(s), Theme(s)</b>	Aerospace Technology, MSM

**Objective 10.2 Create system concepts and demonstrate technologies that will enable new science measurements and scientific missions.**

**APG 3R10:** Complete initial component tests to provide data for evaluating feasibility of key concepts by completing all of the following indicators. **Rating: White**

<b>Accomplishments</b>	NASA cancelled this APG.
<b>Corrective Actions</b>	The investigation of some of the revolutionary propulsion system concepts may be selected via broadly-competed NASA Research Announcements.

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**Source Information** • More information about this APG can be obtained through the Office of Aerospace Technology at NASA Headquarters.

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**Responsible Enterprise(s), Theme(s)** Aerospace Technology, MSM

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**APG 3R12:** *Advance the state-of-the-art in automated data analysis, mission command and communications, and science sensors and detectors that are potentially beneficial for future NASA missions.* **Rating: Green**

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**Accomplishments** NASA achieved this APG.

- Automated Science Data Understanding:
  - a. NASA found a novel feature in data discovery methods from known and new, candidate ocean climate indices that show predictive power for land surface dynamics.
  - b. NASA demonstrated tools and techniques for automated feature extraction from large datasets by using a robust, novel clustering method.
  - c. NASA demonstrated distributed analysis and data processing to support new problem solving paradigms through the application of various grid tools and resources to aerospace vehicle design, data subsetting for feature identification, ground truthing, and wind dynamics applications.
  - d. NASA demonstrated component autonomy technologies in planning and scheduling supporting Mars mission operations by conducting the first full operations readiness test (Port 3) of science planning tool for Mars Exploration Rovers (MER) running on Mars time using MER rover engineering model and involving mission planning teams.
- Mission Command and Data Delivery:
  - a. NASA demonstrated technology capable of two-times improvement in Mars-to-Earth communications by performing analysis on the comparison between the existing state-of-the-art 35 watt Traveling Wave Tube (TWT) against the NASA developed 100 watt TWT. The analysis proved that the NASA-developed 100 watt TWT would improve data rates by a factor of 2.85 times from Mars.
  - b. NASA demonstrated a technology capable of ten-fold improvement in Earth-orbit-to-ground communications via the development of a miniaturized 20-Watt Ka-Band TWT that could increase the data rates by a factor of 15 over the existing NASA 150Mbps Earth-orbit-to-ground link.
  - c. NASA demonstrated capability for ad-hoc space and surface networking via demonstration of the Dynamic Source Routing (DSR) Protocol.
- Science Sensors and Detectors:
  - a. NASA demonstrated molecular-level sensors for environmental health monitoring via demonstration of a gas sensor capable of detecting gas and organic vapors at room temperature.
  - b. NASA demonstrated a high-efficiency, tunable, narrow-line 2-micron laser transmitter with a record 1 Joule pulse energy for 2-micron Ho:Tm:LuLF laser transmitter.
  - c. NASA characterized the HgCdTe Infrared detector and analyzed the spectral response and current versus voltage curves, and presented results at the International Society for Optical Engineering (SPIE) AeroSense Conference.

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**Source Information** • “Data Mining Reveals a New History of Natural Disasters,” NASA Press Release. Available at [http://amesnews.arc.nasa.gov/releases/2003/03\\_51AR.html](http://amesnews.arc.nasa.gov/releases/2003/03_51AR.html).

- “Contingency Planning for Planetary Rovers,” Third International D35 NASA Workshop on Planning and Scheduling for Space. Houston, TX. R. Dearden, N. Meuleau, S. Ramakrishnan, D. Smith, and R. Washington, 2002.

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- “Discovery of Climate Indices using Clustering,” M. Steinbach, P.-N. Tan, V. Kumar, S. Klooster, C. Potter. Available at <http://www.acm.org/sigkdd/kdd2003/papers.html#indust>.
- Additional sources for this APG are available at <http://www.ifmp.nasa.gov/codeb/library/reports.htm>.

**Responsible Enterprise(s),**

**Theme(s)**

Aerospace Technology, MSM

**APG 3R13:** *Advance the state-of-the-art in power / propulsion systems, spacecraft systems, and large or distributed space systems and our knowledge of space environmental effects that are required to support future NASA missions.*

**Rating: Green**

**Accomplishments**

NASA achieved this APG.

- **Advanced Power and Electric Propulsion Systems:**
  - a. NASA demonstrated a two-fold increase in thruster lifetime compared to Deep Space-1 NASA Solar-electric-power technology Application Readiness (NSTAR) thruster with Titanium and Molybdenum ion optics.
  - b. NASA completed Hall thruster lifetime and operating point correlations with ten kilowatt (kW) and 50 kW thrusters.
  - c. NASA completed Hall thruster modeling at the Massachusetts Institute of Technology.
  - d. NASA successfully grew two key parts of high efficiency multi-bandgap solar cell: a GaAs cell on graded Si to Ge substrate, and a two junction LMM cell on GaAs substrate.
  - e. NASA demonstrated a two-flywheel system for regulating power bus voltage while simultaneously providing a commanded output torque for attitude control.
- **Micro and Multipurpose Spacecraft Components and Systems:**
  - a. NASA demonstrated the Vaporizing Liquid Micro-Thruster (VLM) chip integrated with a commercial valve.
  - b. NASA integrated a three-axis inertial measurement unit for microspacecraft using microgyros and commercial accelerometers.
  - c. The alpha voltaic microgenerator was delayed due to redesign of the device.
  - d. NASA demonstrated operation of micro-inductors applicable to DC-DC boost converters between 1-10 MHz.
  - e. NASA assembled and demonstrated sun sensor on a chip using Micro-electro-mechanical system (MEMS)-fabricated Silicon apertures and Active Pixel Sensors.
  - f. NASA fabricated and tested a liquid compatible micro valve, which is a component for microspacecraft propulsion systems.
  - g. NASA fabricated and characterized battery cells, but integration into structural panel has been delayed.
- **Large and Distributed Space Systems Concepts:**
  - a. NASA demonstrated attitude determination of individual spacecraft using GPS receivers.
  - b. NASA developed simplified equations of motion for an uncontrolled system of spacecraft.
  - c. NASA evaluated various joint designs to enable in-space assembly of inflatable truss elements and fabricated inflatable truss components.
  - d. NASA completed fabrication and initial RF testing of subscale tensioned membrane eight-element waveguide array and feed network.
  - e. NASA fabricated an isogrid column using ultraviolet curable resin and unidirectional carbon fiber tows. Test results show 95 percent + curing using only outdoor sunlight.
  - f. NASA fabricated and deployed a seven-meter shape memory composite boom for solar sails.



- g. NASA fabricated proof-of-concept electronic circuits on membrane.
- Space Environments and Effects:
  - a. NASA developed a physics-based meteoroid environment flux model for the inner solar system.
  - b. NASA completed joint NASA/U.S. Air Force development of NASACAP-2K spacecraft charging model.
  - c. NASA determined the electrical properties for a wide array of spacecraft materials and integrated data into spacecraft charging models.
  - d. NASA developed a semi-empirical engineering model of electrons and ions that included the thermal plasma distributions as well as bulk flow effects in the distant magnetotail.
  - e. NASA developed and published the low Earth orbit Spacecraft Charging Guidelines Document.
  - f. NASA developed an initial version of thin-film materials knowledgebase.

<b>Source Information</b>	<ul style="list-style-type: none"> <li>• NASA's Aerospace Technology Program Management Accomplishment System is available at <a href="https://extranet.hq.nasa.gov/pmas_pro/frontdoor.cfm">https://extranet.hq.nasa.gov/pmas_pro/frontdoor.cfm</a>.</li> <li>• Space Environments and Effects Program information is available at <a href="http://see.msfc.nasa.gov">http://see.msfc.nasa.gov</a>.</li> </ul>
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<b>Responsible Enterprise(s), Theme(s)</b>	Aerospace Technology, MSM
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**APG 3R14:** *Demonstrate progress toward achievement of systems that can think, reason, make decisions, adapt to change, and cooperate among themselves and with humans to provide safe and successful aerospace processes and mission functions with greatly reduced human participation by successfully demonstrating individual autonomy components.*

**Rating: Green**

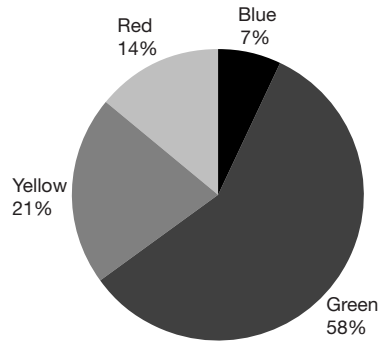
<b>Accomplishments</b>	<p>NASA achieved this APG by demonstrating individual autonomy component technologies that will be included in a larger, integrated demonstration. Component capabilities demonstrated for integrated rover autonomy include:</p> <ul style="list-style-type: none"> <li>■ Mixed-initiative path planning for devising paths to desired science targets;</li> <li>■ Autonomous contingent planning and sequence generation; and</li> <li>■ Robust on-board rover execution of contingent plans.</li> </ul>
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<b>Source Information</b>	<ul style="list-style-type: none"> <li>• Information on individual autonomy component technologies is available at <a href="http://is.arc.nasa.gov/AR/tasklist.html">http://is.arc.nasa.gov/AR/tasklist.html</a>.</li> </ul>
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<b>Responsible Enterprise(s), Theme(s)</b>	Aerospace Technology, MSM
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# Implementing Strategies for Well-Managed Programs

In FY 2003, NASA achieved or exceeded nine of its 14 annual performance goals (APGs) under Implementing Strategies. Significant strides in three APGs resulted in a “yellow” rating, while two goals were not achieved in FY 2003.



## Implementing Strategy 1: Achieve management and institutional excellence comparable to NASA’s technical excellence.

**APG 3MS2:** Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBCs). **Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG.</p> <ul style="list-style-type: none"> <li>■ The Agency exceeded its performance-based contracting goal of 80 percent of contract obligations. As of August 31, 2003, actual accomplishment was 86.9 percent of contract obligations (Office of Procurement).</li> <li>■ NASA uses competitive merit review to ensure the quality of its research programs. In FY 2003, the Earth Science Enterprise used peer review to award 87 percent of its funding for scientific research. The Space Science Enterprise awarded 96 percent of its research funding via peer review. The Office of Biological and Physical Research awarded 92 percent. However, there are cases where innovative, interesting research can be funded to help reach NASA’s goals. Therefore, NASA allows for 20 percent or less of its research to be awarded non-competitively (Office of the Chief Scientist).</li> </ul>
<b>Source Information</b>	<ul style="list-style-type: none"> <li>• <a href="http://ec.msfc.nasa.gov/hq/library/metrics/PBC.pdf">http://ec.msfc.nasa.gov/hq/library/metrics/PBC.pdf</a>.</li> </ul>
<b>Responsible NASA Headquarters Office</b>	Office of Procurement, Office of the Chief Scientist

**APG 3MS3:** Renew the Agency’s management systems and facilities through the use of updated automated systems and facilities revitalization, and meet four out of five performance indicators in this area. **Rating: Yellow**

<b>Accomplishments</b>	<p>NASA failed to achieve this APG, although progress was significant on the following indicators:</p> <ol style="list-style-type: none"> <li>① NASA funded \$191.7 million for facility revitalization to improve the condition of NASA’s facility infrastructure, valued at \$20.3 billion. This is equivalent to a facilities revitalization frequency of 106 years, which is slightly higher than the 100-year goal.</li> <li>② NASA reduced unfunded environmental liability for its operations and facilities. Environmental incidents, toxic chemical usage, and generation of hazardous wastes continue to be systematically reduced and environmental liability levels are dropping as sites are being cleaned up.</li> </ol>
<b>Corrective Actions</b>	<ol style="list-style-type: none"> <li>① Since the 100-year revitalization frequency rate was not achieved, revitalization funding planned for FY 2004 was increased to \$212.3 million to improve the revitalization rate to 97 years. This will exceed our 100-year revitalization frequency goal. We are evaluating</li> </ol>

moving toward a target rate of 67 years, which is a metric used by the Department of Defense.

<b>Source Information</b>	<ul style="list-style-type: none"> <li>• NASA's Facilities Engineering Division and the Agency's real property database.</li> <li>• The unfunded environmental liability balance is a line item in year-end financial statements included in Part 3 of this book.</li> </ul>
<b>Responsible NASA Headquarters Office</b>	Office of Management Systems

**APG 3MS7: *Align management of human resources to best achieve Agency strategic goals and objectives.* Rating: Green**

<b>Accomplishments</b>	<p>NASA achieved this APG.</p> <ul style="list-style-type: none"> <li>■ NASA enhanced the Centers' ability to attract, recruit, and retain a high-quality workforce: <ul style="list-style-type: none"> <li>a. NASA developed a CD-ROM recruitment card that provides applicants with information on NASA's Enterprises, mission, and employment benefits.</li> <li>b. NASA designed and developed a comprehensive employment DVD that showcases many NASA employees and their work. The DVD won the prestigious Telly Award—one of the most sought-after awards in the TV, commercial, and video industries.</li> <li>c. NASA partnered with many top-ranked science and engineering colleges and universities to attract top students to NASA to close critical competency gaps.</li> <li>d. The Offices of Education, Equal Opportunity Programs, and Human Resources formed a formal partnership and developed a five-year corporate recruitment strategy.</li> </ul> </li> <li>■ NASA increased the number and availability of individual, team, and organizational level assessment tools from seven to 17 to support the development and education of all levels of leaders in NASA.</li> </ul>
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<b>Source Information</b>	• The Individual Assessment is available at <a href="http://www.leadership.nasa.gov">http://www.leadership.nasa.gov</a> .
<b>Responsible NASA Headquarters Office</b>	Office of Human Resources

**APG 3MS8: *Attract and retain a workforce that is representative of America's diversity at all levels, and maximize individual performance through training and development experiences.* Rating: Red**

<b>Accomplishments</b>	<p>NASA failed to achieve this APG, but made progress towards the goal of increasing representation of women, minorities, and individuals with targeted disabilities.</p> <p>① NASA was unable to increase representation of minorities (by at least 0.6 percent), women (by at least 0.4 percent) and persons with targeted disabilities (by at least .085 percent). Progress for women and minorities was below the goal (at +.3%) and there was no change in representation of individuals with targeted disabilities.</p>
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Representation	FY 2002	FY 2003	% Change	Goal
Minorities	22.2%	22.5%	+0.3	+0.6
Women	33.1%	33.4%	+0.3	+0.4
Individuals with targeted disabilities	1.03%	1.03%	None	+0.085

<b>Corrective Actions</b>	<p>② NASA met the target for training experiences for women, minorities, and individuals with targeted disabilities. All three groups participated in training experiences at a rate that exceeded their representation in the workforce.</p> <p>NASA's Office of Equal Opportunity Programs plans to review and revise the indicators used to measure achievement of this APG. The indicator for representation, while based on a five-year trend analysis, was nevertheless set arbitrarily. NASA will rework the indicator and link it to civilian labor force data for women and minorities, and to the estimate provided by the U.S. Equal Employment Opportunity Commission, for individuals with targeted disabilities.</p>
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<b>Source Information</b>	<ul style="list-style-type: none"><li>• NASA Consolidated Agency Personnel and Payroll System (CAPPS).</li><li>• NASA AdminSTAR training database.</li></ul>
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<b>Responsible NASA Headquarters Office</b>	Office of Equal Opportunity Programs
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**APG 3MS9:** *Continue integrating small, small disadvantaged, and women-owned businesses together with minority universities into the competitive base from which NASA can purchase goods and services.* **Rating: Blue**

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<b>Accomplishments</b>	NASA significantly exceeded this APG by awarding over 19 percent of the total dollar value of prime and subcontracts to small disadvantaged and women-owned businesses (including Historically Black Colleges and Universities and other minority educational institutions). The congressionally mandated goal is eight percent.
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<b>Source Information</b>	<ul style="list-style-type: none"><li>• The NASA Acquisition Internet Service and the NASA Procurement Management System are both available at <a href="http://procurement.nasa.gov">http://procurement.nasa.gov</a>.</li><li>• Small business information is available at <a href="http://osdbu.nasa.gov">http://osdbu.nasa.gov</a>.</li></ul>
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<b>Responsible NASA Headquarters Office</b>	Office of Small and Disadvantaged Business Utilization
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**APG 3MS10:** *Improve the Agency's financial management and accountability.* **Rating: Green**

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<b>Accomplishments</b>	NASA achieved this APG. <ul style="list-style-type: none"><li>■ NASA completed implementation of the Integrated Financial Management (IFM) program Core Financial system at all ten NASA Centers and the Jet Propulsion Laboratory.</li><li>■ NASA fully implemented the Travel Management module at all ten NASA Centers.</li><li>■ NASA initiated the Budget Formulation module.</li><li>■ NASA began formulation phase of the Integrated Asset Management module.</li><li>■ NASA costed 75.9 percent of its available resources authority, meeting this APG.</li></ul>
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<b>Source Information</b>	<ul style="list-style-type: none"><li>• Information on IFMP Reviews, Core Financial Operational Readiness Reviews and the IFMP Master Schedule can be obtained through NASA's Office of the Chief Financial Officer.</li><li>• NASA's Office of the Chief Financial Officer Web site contains a resource library with links to budgets, policies, plans, and other relevant reports and is available at <a href="http://ifmp.nasa.gov/codeb/index.html">http://ifmp.nasa.gov/codeb/index.html</a>.</li></ul>
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<b>Responsible NASA Headquarters Office</b>	Office of the Chief Financial Officer
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**APG 3P2:** *Track the availability of NASA's spacecraft and major ground facilities by keeping the operating time lost due to unscheduled downtime to less than 10% of scheduled operating time.* **Rating: Yellow**

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<b>Accomplishments</b>	NASA failed to achieve this APG although progress was significant in that NASA lost only 4.5 percent of scheduled operating time due to unscheduled downtime, on average. Although NASA met the goal of less than ten percent operational downtime in FY 2003, the loss of <i>Columbia</i> , was an indicator that NASA engineering has significant room for improvement. Although this metric is a simple average calculation, and the projects such as Space Shuttle and the International Space Station are not weighted, we still consider them to be critical to NASA's Vision and Mission; hence a "yellow" assessment is appropriate. Ground facility data, which was approximately one percent in previous years, was not fully complete at the time of this report, although no significant change is expected.
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<b>Corrective Actions</b>	The <i>Columbia</i> accident prompted the Agency to increase the robustness of engineering processes and best practices.
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<b>Source Information</b>	<ul style="list-style-type: none"><li>• Spacecraft data is contained in operational logs at respective mission operations facilities.</li><li>• NASA Facility Utilization on-line database is available at <a href="https://nrpi.hq.nasa.gov/">https://nrpi.hq.nasa.gov/</a>.</li></ul>
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Responsible NASA  
Headquarters Office

Office of the Chief Engineer, Office of the Administrator

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**Implementing Strategy 2: Demonstrate NASA leadership in the use of information technologies.**

**APG 3MS4:** *Improve IT infrastructure service delivery by providing increased capability and efficiency while maintaining a customer rating of satisfactory.*

**Rating: Green**

**Accomplishments**

NASA achieved this APG by providing increased capabilities while maintaining customer ratings of satisfactory or higher for each service. The NASA Integrated Services Network (NISN), the Agency's core network, was re-designed to increase capacity between the Centers while maintaining a consistent cost. In addition, NISN's service request process was re-engineered to make it more efficient in addressing customer concerns. The Agency's data center, the NASA ADP Consolidation Center (NACC), achieved increased efficiencies by consolidating its disaster recovery testing process, standardizing account management codes, and recycling material resources. NISN and NACC both maintained average annual customer satisfaction ratings of satisfied and very satisfied.

**Source Information**

- <http://www.nisn.nasa.gov/>.
- <http://www.nacc.nasa.gov/>.
- <http://odin.nasa.gov/>.

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Responsible NASA  
Headquarters Office

Office of the Chief Information Officer.

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**APG 3MS5:** *Enhance IT security by meeting established performance indicators in three critical areas.*

**Rating: Green**

**Accomplishments**

NASA achieved this APG.

- ① NASA achieved a significant reduction in the most critical Information Technology (IT) security vulnerabilities through an effort that focused on vulnerabilities with the greatest potential to significantly disrupt NASA's operations. Systems that continue to exhibit critical vulnerabilities must be disconnected from the network until properly secured.
- ② NASA trained 97 percent of employees and 97 percent of managers in IT security.
- ③ NASA completed IT security plans for 100 percent of the Agency's IT systems and is tracking the status of all plans through an Agency-wide security plan registry.

**Source Information**

- IT security data was collected from all NASA Centers.

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Responsible NASA  
Headquarters Office

Office of the Chief Information Officer

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**APG 3MS6:** *Enhance mission success through seamless, community-focused electronic service delivery by meeting the established performance indicators in this area.*

**Rating: Green**

**Accomplishments**

NASA achieved this APG.

- NASA established the Integrated Information Infrastructure Program to provide an infrastructure that can evolve and adapt to emerging technologies and service models and enable effective and efficient integration with Federal e-Government initiatives.
- NASA redesigned and launched a new Web portal that offers a single place where all of the public can access the best of NASA's web offerings and, through the MyNASA sub-site, customize the content they want to see. Between February and June 2003, the Portal received over 1.4 billion hits. The redesigned NASA portal (<http://www.nasa.gov>) was deployed on February 1, 2003 and expanded on June 14, 2003. NASA's overall Web site customer satisfaction rating is 78.2, which puts NASA at the high end of customer satisfaction with government Web sites.

Source Information	• <a href="http://www.hq.nasa.gov/office/codea/pma/pages/home.html">http://www.hq.nasa.gov/office/codea/pma/pages/home.html</a> .
Responsible NASA	
Headquarters Office	Office of the Chief Information Officer, Office of Public Affairs

**Implementing Strategy 3: Enhance NASA's core engineering, management, and science capabilities and processes to ensure safety and mission success, increase performance and reduce cost.**

**APG 3P3:** *Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships.* **Rating: Green**

**Accomplishments** NASA exceeded this APG by contributing 20.5 percent of its research and development investment to commercial partnerships.

**Source Information** • <http://www.nctn.hq.nasa.gov/>.

**Responsible NASA**

**Headquarters Office** Office of the Chief Engineer

**APG 3R15:** *Implement an effective oversight process to insure that the research programs are addressing the correct areas, meeting user requirements, have the proper balance, are properly formulated and planned, and are making sufficient process toward the Enterprise goals.* **Rating: Green**

**Accomplishments** NASA achieved this APG by signing all program, project, and sub-project plans to form the basis for oversight and evaluation before the fiscal year began. Categories of oversight conducted included: quality reviews of aeronautics technology (the second of three triennial reviews by the National Research Council); relevance reviews of all three themes and their programs by the ATAC; and performance reviews through a non-advocate review of the ECS program, as well as quarterly status reviews of all themes by the Enterprise Program Management Council.

**Source Information** • Data is available through the Strategy, Communication and Program Integration Division of the Aerospace Technology Enterprise.

**Responsible Enterprise(s),**

**Theme(s)** Aerospace Technology Enterprise, AT, SLI, MSM, ITTP

**Implementing Strategy 4: Ensure that all NASA work environments, on Earth and in space, are safe, healthy, environmentally sound, and secure.**

**APG 3MS1:** *NASA will increase the safety of its infrastructure and the health of its workforce through facilities safety improvements, reduced environmental hazards, increased physical security, enhanced safety and health awareness, and appropriate tools and procedures for health enhancement.* **Rating: Yellow**

**Accomplishments** NASA failed to achieve the first indicator of this APG due to the loss of *Columbia*. However, NASA achieved the remaining indicators for this APG.

- ❶ The loss of *Columbia* and its seven-person crew was a major mishap. The crew consisted of one NASA civil servant, five U.S. Department of Defense military personnel, and one foreign national military member. Details on the *Columbia* accident and NASA's response can be found in the *Columbia* section of this report.
- ❷ Per the Federal Worker 2000 Initiative, NASA reduced the overall occurrence of injuries (due to occupational injury or illness) to 0.80 total cases per 100 workers (the goal was 1.18 total cases per 100 workers).
- ❸ NASA continued its critical infrastructure security vulnerability mitigation activity. Implemented enhanced IT security measures, significantly improving security posture for



critical Agency classified information and communications systems. Enhanced liaisons with the intelligence community for more timely and relevant support.

④ NASA's Occupational Health Program (OHP) increased health awareness by: providing quarterly preventive health initiatives for employees standardized across all Centers; ensuring quality of medical services by providing numerous continuing education activities to assure the competency of NASA health care providers; and by performing regular evaluations at all Centers.

<b>Corrective Actions</b>	<ul style="list-style-type: none"> <li>■ NASA will respond to both the technical and the cultural causes of the <i>Columbia</i> accident as reported by the <i>Columbia</i> Accident Investigation Board by doing a complete review of its Safety and Mission Assurance Program policies, standards, and procedures. NASA will communicate the changes and improvements made in support of return to flight to all Agency programs. NASA will continue its emphasis on prevention of injury and mishaps and will increase the emphasis on safety within the program and engineering communities to ensure that safety and risk management policies and procedures are appropriately applied within NASA research and development programs.</li> </ul>
<b>Source Information</b>	<ul style="list-style-type: none"> <li>• Injury data is available through the Department of Labor's Office of Workers Compensation database.</li> <li>• Workforce staffing strength data is available at <a href="http://www.hq.nasa.gov/office/code/fm_home.html">http://www.hq.nasa.gov/office/code/fm_home.html</a>.</li> <li>• <a href="http://ohp.nasa.gov/">http://ohp.nasa.gov/</a></li> </ul>
<b>Responsible NASA Headquarters Office(s)</b>	Office of Safety and Mission Assurance, Office of Security Management and Safeguards, Office of the Chief Health and Medical Officer

**Implementing Strategy 5: Manage risk and cost to ensure success and provide the greatest value to the American public.**

**APG 3P1:** *Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110 % of cost and schedule estimates, on average.* **Rating: Red**

<b>Accomplishments</b>	<p>NASA failed to achieve this APG.</p> <ul style="list-style-type: none"> <li>■ NASA examined development cost changes for 18 projects across the Agency, and the average increase in development cost from the initial baseline estimate to the FY 2005 draft budget submit (which reflects programmatic events through the summer of FY 2003) was 18.6 percent, with seven projects coming within ten percent of the baseline estimate. The average change in development cost from the FY 2003 budget submit to the FY 2005 draft budget submit (effectively using the FY 2003 numbers as a new baseline and reflecting changes since that time) was -0.5 percent (NOTE: Without the significant reduction to the ISS Research Capability, the average increase would have been 2.4%), with eleven projects coming within ten percent of the FY 2003 numbers.</li> <li>■ In the area of development schedule changes, the average increase in development schedule from the initial baseline estimate to the FY 2005 draft budget submit was 33.1 percent, with four projects coming within ten percent of the baseline schedule. The average increase in development schedule from the FY 2003 budget submit to the FY 2005 draft budget submit was 10.9 percent, with eight projects coming within ten percent of their FY 2003 schedules.</li> </ul>
<b>Corrective Actions</b>	NASA managers are examining a number of ways to ensure that project development cost and schedule estimates remain close to the initial baseline numbers. The independent cost estimating capability, used to support the development of initial baselines, has been increased at Headquarters. In addition, some programs are looking into increasing the percentage of reserves held in the projects to deal with technical difficulties that arise

during the development phase. Finally, some reporting mechanisms, such as ERASMUS, are being instituted to provide greater visibility into program health at all levels of the Agency.

Historically, project cost and schedule baselines have been established very early in a project's life cycle. This is too early, since the design is incomplete, and in some cases the requirements are not complete. Baselines for new projects will be established after the Non-Advocate Review "approval to proceed" into phase C/D, hence the cost and schedule should track closely to the baselines.

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**Source Information**

- Cost and schedule data used in this rating are derived from NASA's FY 2004 Integrated Budget and Performance Document, legacy budget and schedule records resident in the Enterprises and the Office of the Chief Financial Officer, and our FY 2005 draft budget submit available through The Chief Financial Officer's (CFO) Web site at <http://ifmp.nasa.gov/codeb/index.html>.
- The Office of the Chief Engineer's Web site is available at <http://www.hq.nasa.gov/office/codea/codeae/>.

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**Responsible NASA****Headquarters Office**

Office of the Chief Engineer, supported by the Office of the Chief Financial Officer.

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**PART**  
**3**

**Financials**





## A Letter from the Chief Financial Officer

Provided in this section of the National Aeronautics and Space Administration's (NASA) *Fiscal Year 2003 Performance and Accountability Report*, prepared in accordance with the *Reports Consolidation Act (RCA)* of 2000, are the financial statements and associated audit reports. Unfortunately, NASA received a disclaimer of audit opinion for the FY 2003 financial statements.

It is disconcerting to receive a disclaimer of an audit opinion. However, it helps underscore the significant amount of work and challenges facing our NASA financial management team for 2004, challenges that we accept willingly.

Throughout most of FY 2003, NASA was implementing, in phases, a commercial, off-the-shelf, Agency-wide, integrated financial management system (SAP Core Financials application module) replacing 10 disparate accounting systems in operation at our Centers for the past two decades. This conversion effort created some complex accounting issues for FY 2003 that significantly impacted the timeliness and initial quality of the information required in preparing NASA's interim and year-end financial statements.

NASA anticipated that FY 2003 would be an especially challenging time for its external financial reporting activities as eight of ten Centers went through this conversion process. As a result, NASA had to use "blended" data from each Center's legacy accounting system and the new SAP Core Financials system to prepare our consolidated FY 2003 financial statements.

Unfortunately, severe initial data quality issues related to the conversion effort negatively affected our ability to prepare our financial statements in a timely manner. This resulted in the current disclaimer of an audit opinion.

Moving forward, NASA will consider all audit recommendations made and will work with the Office of Inspector General and its auditors to develop and implement the necessary planned corrective actions responsive to the FY 2003 audit findings. We also will be working in earnest to achieve better results for FY 2004.

In spite of the audit opinion, it is important to recognize the dedicated efforts of all NASA employees and contractors at Headquarters, the Centers, and the Competency Center for

their support in our efforts to improve financial management within this Agency. I truly appreciate all of the work performed, and the professionalism demonstrated by everyone in helping me in this effort.

My staff and I look forward to working with NASA employees, contractors, the OIG, and its external auditors during the coming year to significantly improve our future financial statement audit results.

A large, stylized handwritten signature in black ink, reading "Gwendolyn Brown". The signature is written in a cursive style with a large loop at the beginning and a long tail that extends downwards and to the left.

Gwendolyn Brown  
Chief Financial Officer



## Financial Overview

### SUMMARY OF FINANCIAL RESULTS, POSITION, AND CONDITION

NASA's financial statements were prepared to Report the financial position and results of operations of the Agency. The principal financial statements include the 1) Consolidated Balance Sheet, 2) Consolidated Statement of Net Cost, 3) Consolidated Statement of Changes in Net Position, 4) Combined Statement of Budgetary Resources, and 5) Consolidated Statement of Financing. Additional financial information is also presented in the required supplementary schedules.

The *Chief Financial Officer's Act* of 1990 requires that agencies prepare financial statements to be audited in accordance with Government Auditing Standards. While the financial statements were prepared from the books and records of NASA in accordance with formats prescribed by the Office of Management and Budget (OMB), they are in addition to financial reports, prepared from the same books and records, used to monitor and control budgetary resources. The statements should be read with the realization that NASA is a component of the U.S. Government, a sovereign entity.

The following paragraphs briefly describe the nature of each required financial statement and its relevance. Significant account balances and financial trends are discussed to help clarify their impact upon operations.

#### Consolidated Balance Sheet

The Consolidated Balance Sheet on page 144 is presented in a comparative format providing financial information for FY 2003 and FY 2002. It presents assets owned by NASA, amounts owed (liabilities), and amounts that constitute NASA's equity (net position). The Consolidated Balance Sheet reflects total assets of \$46.9 billion and liabilities of \$ 3.9 billion for FY 2003. Unfunded liabilities reported in the statements cannot be liquidated without legislation that provides resources to do so.

About 82 percent of the assets are Property, Plant, and Equipment (PP&E), with a book value of \$36.6 billion. PP&E is property located at the Centers, in space, and in the custody of contractors. Almost 78 percent of PP&E consists of assets held by NASA, while the remaining 12 percent represents property in the custody of contractors. The book

value of Assets in Space, various spacecraft operating above the atmosphere for exploration purposes, constitutes \$17.9 billion, or 63 percent of NASA-owned and -held PP&E.

Cumulative Results of Operations represents the public's investment in NASA, akin to stockholder's equity in private industry. The public's investment in NASA is valued at \$38.7 billion. The Agency's \$43 billion net position includes \$4.3 billion of unexpended appropriations (undelivered orders and unobligated amounts or funds provided, but not yet spent). Net position is presented on both the Consolidated Balance Sheet and the Consolidated Statement of Changes in Net Position.

#### Consolidated Statement of Net Cost

The Consolidated Statement of Net Cost on page 145 presents the "income statement" (the annual cost of programs) and distributes fiscal year expenses by programmatic category. A chart depicting the distribution of expenses can be found under the heading "Appropriations Used (Costs Expended by Enterprise)" contained in this overview. The Net Cost of Operations is reported on the Consolidated Statement of Net Cost, the Consolidated Statement of Changes in Net Position, and also on the Combined Statement of Financing.

NASA makes substantial research and development investments on behalf of the Nation. These amounts are expensed as incurred in determining the net cost of operations. Total Program Expenses are reported on the Consolidated Statement of Net Cost and also on the Required Supplementary Stewardship Information statement regarding Stewardship Investments: Research and Development. Research and Development (R&D) includes all direct, incidental, or related costs resulting from, or necessary to, performance of R&D, regardless of whether the R&D is performed by a Federal agency or by individuals and organizations under grant or contract. R&D investments identified by program on the Required Supplementary Stewardship Information statement regarding Stewardship Investments: Research and Development relates back to program expenses shown on the Consolidated Statement of Net Cost.

These investments are categorized by basic research, applied research, and development. The objective of basic research is to gain fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind. The objective of applied research is to gain knowl-

edge or understanding necessary for determining the means by which a recognized and specific need may be met. Development is the systematic use of the knowledge or understanding gained from research directed toward the production of useful materials, devices, systems, or methods, including design and development of prototypes and processes. It excludes quality control, routine product testing, and production.

The NASA Strategic Plan establishes a framework for making management decisions by separating the Agency's programs into six Strategic Enterprises through which we implement our mission and communicate with external customers. These Enterprises are Human Exploration and Development of Space, Space Science, Earth Science, Biological and Physical Research, Aerospace Technology, and Education Programs.

Funds are allocated by appropriation and then translated into programs. The Consolidated Statement of Net Costs distributes fiscal year expenses by programmatic category (budget line item).

### **Consolidated Statement of Changes in Net Position**

The Consolidated Statement of Changes in Net Position displayed on page 147 identifies appropriated funds used as a financing source for goods, services, or capital acquisitions. This Statement presents the accounting events that caused changes in the net position section of the Consolidated Balance Sheet from the beginning to the end of the reporting period.

### **Combined Statement of Budgetary Resources**

The Combined Statement of Budgetary Resources on page 148 highlights budget authority for the Agency and provides information on budgetary resources available to NASA for the year and the status of those resources at the end of the year. Detail regarding amounts reported on the Combined Statement of Budgetary Resources is included in Required Supplementary Information: Combined Schedule of Budgetary Resources. Outlays reported in this statement reflect cash disbursements for the fiscal year by the U.S. Department of the Treasury for NASA.

For FY 2003, Congress provided total appropriations of \$15.5 billion to NASA. Budget Authority is the authority provided by Federal law to incur financial obligations that will eventually result in outlays or expenditures. Specific forms of gross budget authority for NASA are appropriations and spending authority from offsetting collections.

Funding was received and allocated through the following appropriations:

- **Human Space Flight**—This appropriation provided for the International Space Station and Space Shuttle programs, including the development of research facilities for the ISS; continuing safe, reliable access to space through augmented investments to improve Space Shuttle safety; support of payload and expendable launch vehicle (ELV) operations; and other investments including innovative technology development and commercialization.
- **Science, Aeronautics, and Technology**—This appropriation provided for NASA's research and development activities, including all science activities, global change research, aeronautics, technology investments, education programs, space operations, and direct program support.
- **Inspector General**—This appropriation provided for the workforce and support required to perform audits, evaluations, and investigations of programs and operations.

### **Consolidated Statement of Financing**

The Consolidated Statement of Financing on page 149 provides the reconciliation between the obligations incurred to finance operations and the net costs of operating programs. Costs that do not require resources include depreciation.

Costs capitalized on the Consolidated Balance Sheet are additions to capital assets made during the fiscal year. Obligations Incurred include amounts of orders placed, contracts awarded, services received, and similar transactions that require payment during the same or a future period. Obligations Incurred links the Combined Statement of Budgetary Resources to the Combined Statement of Financing.

## **REQUIRED SUPPLEMENTARY STEWARDSHIP INFORMATION**

Required Supplementary Stewardship Information (RSSI) is included to provide information (financial and non-financial) on resources and responsibilities that cannot be measured in traditional financial reports.

RSSI—Heritage Assets are properties, plant, and equipment that possess historical or natural significance; cultural, educational, or aesthetic value; or significant architectural characteristics. Heritage assets are reported in terms of physical units because their existence is of primary relevance. For FY 2003, NASA reported 1.597 heritage assets. RSSI—Stewardship Investments (R&D)—Stewardship Investments are NASA-funded investments that yield long-term benefits to the general public. Investments in research are shown in this statement as basic research, applied research, and development.

In FY 2003, R&D expenses totaled approximately \$7 billion and included activities to extend knowledge of Earth, its space environment, and the universe; and to invest in new aeronautics and advanced space transportation technologies that support the development and application of technologies critical to the economic, scientific, and technical competitiveness of the United States. The R&D and non-R&D expenses identified by program on the RSSI statement regarding Stewardship Investments: Research and Development tie back to the related program expenses found on the Consolidated Statement of Net Cost.

## **REQUIRED SUPPLEMENTARY INFORMATION**

Required Supplementary Information (RSI) is included to present a complete picture of financial results, position, and condition. This information comprises intragovernmental activities, deferred maintenance, and budgetary resources. Intragovernmental Activities are transactions that occur between Federal agencies. Deferred Maintenance is maintenance that was not performed when it should have been or was scheduled to be performed and delayed until a future period.

The budget for FY 2003 is reflected in three appropriations: Human Space Flight (HSF); Science, Aeronautics and Technology (SAT); and the Inspector General. In FY 2003, funding for the Deep Space Network, Ground Network, and the Western Aeronautical Test Range was budgeted in Science, Aeronautics and Technology appropriation rather than in Human Space Flight appropriation as was done in FY 2002.

The budget for FY 2003 includes both near-term priorities, such as flying the Space Shuttle safely and building the ISS, and longer term investments in America's future, such as developing more affordable, reliable means of access to space and conducting cutting-edge scientific and technological research. The budget draws on strengths in engineering and science and reflects the revolutionary insights and capabilities on the horizon in areas such as biotechnology, nanotechnology, and information technology. It describes the vision for expanding air and space frontiers, serving America, and improving life on Earth. The President's NASA budget request for FY 2003 supports these goals.

**National Aeronautics and Space Administration  
Consolidated Balance Sheet  
As of September 30, 2003 and September 30, 2002**

(In Thousands of Dollars)

**Assets:**

	<u>2003</u>	<u>2002</u>
Intragovernmental Assets:		
Fund Balance with Treasury (Note 2)	\$ 7,492,506	\$ 6,766,494
Investments (Note 3)	17,138	17,083
Accounts Receivable, Net (Note 4)	61,144	53,544
Advances and Prepaid Expenses	7,399	21,274
<b>Total Intragovernmental Assets:</b>	<u>7,578,187</u>	<u>6,858,395</u>
Accounts Receivable, Net (Note 4)	3,607	8,972
Materials and Supplies (Note 5)	2,679,477	2,208,064
Property, Plant and Equipment, Net (Note 6)	36,624,536	34,973,293
Advances and Prepaid Expenses	5,270	44,907
<b>Total Assets</b>	<u><b>\$ 46,891,077</b></u>	<u><b>\$ 44,093,631</b></u>

**Liabilities:**

Intragovernmental Liabilities:		
Accounts Payable	\$ 96,931	\$ 181,244
Other Liabilities (Notes 7 and 8)	74,022	232,713
<b>Total Intragovernmental Liabilities</b>	<u>170,953</u>	<u>413,957</u>
Accounts Payable	2,144,112	2,326,774
Environmental Cleanup (Notes 1 and 8)	1,096,109	1,271,937
Other Liabilities (Notes 7 and 8)	458,625	418,480
<b>Total Liabilities</b>	<u><b>3,869,799</b></u>	<u><b>4,431,148</b></u>

**Net Position:**

Unexpended Appropriations	4,291,001	3,903,145
Cumulative Results of Operations	38,730,277	35,759,338
<b>Total Net Position</b>	<u><b>43,021,278</b></u>	<u><b>39,662,483</b></u>
<b>Total Liabilities and Net Position</b>	<u><b>\$ 46,891,077</b></u>	<u><b>\$ 44,093,631</b></u>

The accompanying notes are an integral part of this statement.

**National Aeronautics and Space Administration**  
**Consolidated Statement of Net Cost**  
**For the Fiscal Years Ending September 30, 2003 and September 30, 2002**  
*(In Thousands of Dollars)*

	2003	2002
<b>Program Costs by Enterprise:</b>		
<b>Human Exploration and Development of Space</b>		
Intragovernmental Costs	\$ 343,440	\$ 410,872
Less: Intragovernmental Earned Revenue	221,191	209,994
Intragovernmental Net Costs	<u>122,249</u>	<u>200,878</u>
Gross costs with the Public	5,103,285	6,105,276
Less: Earned Revenue from the Public	26,050	24,731
Net Costs with the Public	<u>5,077,235</u>	<u>6,080,545</u>
Total Net Cost	<u>5,199,484</u>	<u>6,281,423</u>
<b>Space Science</b>		
Intragovernmental Costs	153,162	156,399
Less: Intragovernmental Earned Revenue	49,023	41,287
Intragovernmental Net Costs	<u>104,139</u>	<u>115,112</u>
Gross costs with the Public	2,655,656	2,711,782
Less: Earned Revenue from the Public	2,771	2,334
Net Costs with the Public	<u>2,652,885</u>	<u>2,709,448</u>
Total Net Cost	<u>2,757,024</u>	<u>2,824,560</u>
<b>Earth Science</b>		
Intragovernmental Costs	432,973	498,131
Less: Intragovernmental Earned Revenue	337,854	361,219
Intragovernmental Net Costs	<u>95,119</u>	<u>136,912</u>
Gross costs with the Public	1,185,104	1,363,449
Less: Earned Revenue from the Public	11,386	12,174
Net Costs with the Public	<u>1,173,718</u>	<u>1,351,275</u>
Total Net Cost	<u>1,268,837</u>	<u>1,488,187</u>
<b>Biological and Physical Research</b>		
Intragovernmental Costs	63,512	33,375
Less: Intragovernmental Earned Revenue	18,554	425
Intragovernmental Net Costs	<u>44,958</u>	<u>32,950</u>
Gross costs with the Public	1,308,828	687,777
Less: Earned Revenue from the Public	23,749	544
Net Costs with the Public	<u>1,285,079</u>	<u>687,233</u>
Total Net Cost	<u>1,330,037</u>	<u>720,183</u>
<b>Aerospace Technology</b>		
Intragovernmental Costs	97,132	223,290
Less: Intragovernmental Earned Revenue	30,627	57,724
Intragovernmental Net Costs	<u>66,505</u>	<u>165,566</u>
Gross costs with the Public	1,140,563	2,621,948
Less: Earned Revenue from the Public	9,699	18,280
Net Costs with the Public	<u>1,130,864</u>	<u>2,603,668</u>
Total Net Cost	<u>1,197,369</u>	<u>2,769,234</u>
<b>Education Programs (formerly Academic Programs)</b>		
Gross costs with the Public	169,562	115,580
Less: Earned Revenue from the Public	606	465
Net Costs with the Public	<u>168,956</u>	<u>115,115</u>
Total Net Cost	<u>168,956</u>	<u>115,115</u>

The accompanying notes are an integral part of this statement.

**National Aeronautics and Space Administration**  
**Consolidated Statement of Net Cost**  
**For the Fiscal Years Ending September 30, 2003 and September 30, 2002 (continued)**  
*(In Thousands of Dollars)*

	<u>2003</u>	<u>2002</u>
<b>Other Programs</b>		
Intragovernmental Costs	54,251	140,672
Less: Intragovernmental Earned Revenue	311	1,703
Intragovernmental Net Costs	<u>53,940</u>	<u>138,969</u>
Total Net Cost	<u>53,940</u>	<u>138,969</u>
<b>Net cost of operations (Notes 11 and 14)</b>	<b><u>\$ 11,975,647</u></b>	<b><u>\$ 14,337,671</u></b>

The accompanying notes are an integral part of this statement.



**National Aeronautics and Space Administration**  
**Consolidated Statement of Changes in Net Position**  
**For the Fiscal Years Ending September 30, 2003 and September 30, 2002**  
*(In Thousands of Dollars)*

	<b>2003</b>		<b>2002</b>	
	<b>Cumulative Results of Operations</b>	<b>2003 Unexpended Appropriations</b>	<b>Cumulative Results of Operations</b>	<b>2002 Unexpended Appropriations</b>
Beginning Balances (Note 1)	\$ 35,759,338	\$ 3,903,145	\$ 35,885,693	\$ 3,325,591
<b>Budgetary Financing Sources:</b>				
Appropriations Received	–	15,464,165	–	14,902,826
Appropriations Used	14,707,384	(14,707,384)	14,282,068	(14,282,068)
Appropriations Transferred In/Out	–	(125)	–	–
Unexpended Appropriations—Adjustments	–	(368,800)	–	(43,204)
Nonexchange Revenue	1,049	–	1,212	–
Donations	6	–	3	–
<b>Other Financing Sources:</b>				
Donations of Property	3,231	–	–	–
Transfers In/(Out) Without Reimbursement	104,620	–	(284,401)	–
Imputed Financing	130,296	–	212,434	–
<b>Total Financing Sources</b>	<b>14,946,586</b>	<b>387,856</b>	<b>14,211,316</b>	<b>577,554</b>
<b>Net Cost of Operations</b>	<b>(11,975,647)</b>	<b>–</b>	<b>(14,337,671)</b>	<b>–</b>
<b>Ending Balances</b>	<b>\$ 38,730,277</b>	<b>\$ 4,291,001</b>	<b>\$ 35,759,338</b>	<b>\$ 3,903,145</b>

The accompanying notes are an integral part of this statement.

**National Aeronautics and Space Administration**  
**Combined Statement of Budgetary Resources**  
**For the Fiscal Years Ending September 30, 2003 and September 30, 2002**  
*(In Thousands of Dollars)*

	<u>2003</u>	<u>2002</u>
<b>Budgetary Resources:</b>		
<b>Budgetary authority:</b>		
Appropriation Received	\$15,451,354	\$14,902,826
Net Transfers, Current Year Authority	(125)	-
<b>Unobligated balance:</b>		
Unobligated Balance, Brought Forward, October 1	1,127,920	873,941
<b>Spending from Offsetting Collections:</b>		
Earned		
Collected	720,031	759,500
Receivable from Federal Sources	2,617	(17,160)
Change in Unfilled Orders		
Advance Received	(32,167)	131,502
Without Advance from Federal Sources	(64,203)	(58,610)
<b>Recoveries of prior year obligations, actual</b>	<b>181,530</b>	<b>102,353</b>
<b>Permanently not available</b>		
Cancellations of Expired/No-Year Accounts	(45,733)	(36,935)
Authority Unavailable Pursuant to Public Law	(75,258)	(10,013)
<b>Total Budgetary Resources</b>	<b>17,265,966</b>	<b>16,647,404</b>
<b>Status of Budgetary Resources:</b>		
<b>Obligations Incurred (Note 13)</b>		
Direct	14,859,449	14,789,386
Reimbursable	778,297	730,098
<b>Total Obligations Incurred</b>	<b>15,637,746</b>	<b>15,519,484</b>
<b>Unobligated Balance</b>		
Apportioned, Currently Available	1,550,693	936,119
Trust Funds	3,616	-
Not Available, Other	73,911	191,801
<b>Total Unobligated Balances</b>	<b>1,628,220</b>	<b>1,127,920</b>
<b>Status Budgetary Resources</b>	<b>17,265,966</b>	<b>16,647,404</b>
<b>Obligated Balance, Net as of October 1</b>	<b>5,633,407</b>	<b>5,460,861</b>
<b>Obligated Balance, End of Period</b>		
Accounts Receivable	(61,100)	(58,094)
Unfilled Customer Orders	9,580	(54,623)
Undelivered Orders	3,608,790	3,113,677
Accounts Payable	2,354,273	2,632,836
<b>Outlays</b>		
Disbursements	15,239,665	15,320,357
Collections	(687,864)	(891,002)
<b>Subtotal</b>	<b>14,551,801</b>	<b>14,429,355</b>
Less: Offsetting Receipts	6	3
<b>Net Outlays</b>	<b>\$ 14,551,795</b>	<b>\$ 14,429,352</b>

The accompanying notes are an integral part of this statement.

**National Aeronautics and Space Administration**  
**Consolidated Statement of Financing**  
**For the Fiscal Years Ending September 30, 2003 and September 30, 2002**  
*(In Thousands of Dollars)*

	<u>2003</u>	<u>2002</u>
<b>Resources Used to Finance Activities:</b>		
<b>Budgetary Resources Obligated</b>		
Obligations Incurred	\$ 15,637,746	\$ 15,519,484
Less: Spending authority from offsetting collections and recoveries	(807,808)	(917,585)
Obligations net of offsetting collections and recoveries	14,829,938	14,601,899
Less: Offsetting receipts	6	3
<b>Net obligations</b>	<b>14,829,932</b>	<b>14,601,896</b>
<b>Other Resources:</b>		
Donations of Property	3,231	-
Transfers In/Out Without Reimbursements	104,620	-
Imputed financing from costs absorbed by others	130,296	212,434
<b>Net Other Resources Used to Finance Activities</b>	<b>238,147</b>	<b>212,434</b>
<b>Total Resources Used to Finance Activities</b>	<b>15,068,079</b>	<b>14,814,330</b>
<b>Resources Used to Finance Items not Part of the Net Cost of Operations</b>		
Change in Budgetary Resources Obligated for Goods, Services and Benefits Ordered But Not Yet Provided	(881,272)	(384,825)
Resources That Fund Expenses Recognized in Prior Periods	(192,455)	(165,806)
Budgetary Offsetting Collections and Receipts that Do Not Affect the Net Costs of Operations—Other	(6,631)	1,212
Resources that Finance the Acquisition of Assets	(5,530,972)	(3,621,434)
Other Resources or Adjustments to Net Obligated Resources That Do Not Affect Net Cost of Operation	(104,745)	-
<b>Total Resources Used to Finance Items Not Part of the Net Cost of Operations</b>	<b>(6,716,075)</b>	<b>(4,170,853)</b>
<b>Total Resources Used to Finance the Net Cost of Operations</b>	<b>8,352,004</b>	<b>10,643,477</b>
<b>Components Net Cost that Will Not Require or Generate Resources in the Current Period</b>		
<b>Components Requiring or Generating Resources in Future Periods</b>		
Increases in Annual Leave Liability	12,989	-
Increase in Exchange revenue Receivable from the Public	2,254	-
Other	51,018	-
<b>Total Components of Net Cost that will Require or Generate Resources in Future Periods</b>	<b>66,261</b>	<b>-</b>
<b>Components Not Requiring or Generating Resources</b>		
Depreciation	3,348,775	3,694,194
Revaluation of Assets or Liabilities	211,574	-
Other	(2,967)	-
<b>Total Components of Net Cost of Operations that will not Require or Generate Resources</b>	<b>3,557,382</b>	<b>3,694,194</b>
<b>Total Components of Net Cost of Operations that will not Require or Generate Resources in the Current Period</b>	<b>3,623,643</b>	<b>3,694,194</b>
<b>Net Cost of Operations</b>	<b>\$ 11,975,647</b>	<b>\$ 14,337,671</b>

The accompanying notes are an integral part of this statement.

## **1. SUMMARY OF ACCOUNTING POLICIES AND OPERATIONS**

### **Reporting Entity**

NASA is an independent Agency established to plan and manage the future of the Nation's civil aeronautics and space program. It has six Strategic Enterprises—Human Exploration and Development of Space, Space Science, Earth Science, Biological and Physical Research, Aerospace Technology, and Education Programs—to implement its mission and communicate with external customers. These Financial Statements reflect all activities including those of its nine Centers, Headquarters, and the Jet Propulsion Laboratory, which is a Federally Funded Research and Development Center owned by NASA but managed by an independent contractor. Financial management of operations is the responsibility of officials at all organizational levels. During FY 2003 NASA replaced the 10 non-integrated accounting systems located at the NASA Centers and Headquarters. NASA implemented a new single integrated commercial off-the-shelf financial management system to significantly improve NASA's financial management system. Although each Center is independent and has its own Chief Financial Officer, they operate under Agency-wide financial management policies. The new single integrated accounting system provides basic information necessary to meet internal and external budget and financial reporting requirements and provides funds control and accountability. All significant intra-entity activities have been eliminated.

### **Basis of Presentation**

These Financial Statements include the Consolidated Balance Sheet as of September 30, 2003 and September 30, 2002, the related Consolidated Statement of Net Cost, Consolidated Statement of Changes in Net Position, Combined Statement of Budgetary Resources, and the Consolidated Statement of Financing for the fiscal years ended September 30, 2003 and September 30, 2002, respectively, as required by the Chief Financial Officer's Act of 1990 and the Government Management Reform Act of 1994. They were prepared from the books and records of NASA, in accordance with Generally Accepted Accounting Principles and accounting policies and practices summarized in this note. These Financial Statements were prepared under the accrual basis of accounting, where expenses and revenues are recorded in the period in which they are incurred or earned, respectively.

### **Budgets and Budgetary Accounting**

NASA is funded by three appropriations, which require individual treatment in the accounting and control system. Reimbursements to appropriations total approximately \$732 and \$731 million for FYs 2003 and 2002, respectively. As part of its reimbursable program, NASA launches devices into space and provides tracking and data relay services for the U.S. Department of Defense, the National Oceanic and Atmosphere Administration, and the National Weather Service.

On the Statement of Budgetary Resources, Unobligated Balances-Available represents the amount remaining in accounts that are available for obligation in future fiscal years. Unobligated Balances-Not Available represents the amount remaining in appropriation accounts that can only be used for adjustments to previously recorded obligations.

### **Use of Estimates**

Preparation of financial statements in conformity with Generally Accepted Accounting Principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent liabilities as of the date of the financial statements and the reported amounts of revenues and expenses during the reporting period. Actual results could differ from these estimates.

### **Fund Balance with Treasury**

Cash receipts and disbursements are processed by Treasury. Fund Balance with Treasury includes appropriated funds, trust funds, deposit funds, and budget clearing accounts.

### **Investments in U.S. Government Securities**

Intragovernmental non-marketable securities includes the following investments:

- (1) National Aeronautics and Space Administration Endeavor Teacher Fellowship Trust Fund established from public donations in tribute to the crew of the Space Shuttle Challenger.
- (2) Science Space and Technology Education Trust Fund established for programs to improve science and technology education.

### **Accounts Receivable**

Most receivables are for reimbursement of research and development costs related to satellites and launch services. The allowance for uncollectible accounts is based upon evaluation of accounts receivable, considering the probability of failure to collect based upon current status, financial and other relevant characteristics of debtors, and the relationship with the debtor. Under a cross-servicing arrangement, accounts receivables over 180 days delinquent are turned over to Treasury for collection (the receivable remains on NASA's books until Treasury determines the receivable is uncollectible).

### **Advances to Others**

NASA provides funds to recipients under the University Contracts and Grants Program by drawdowns on letters of credit or through predetermined payment schedules. Recipients are required to schedule drawdowns to coincide with actual, immediate cash needs, in accordance with Treasury regulations. Quarterly reporting by recipients is provided on Federal Cash Transaction Reports (SF 272). The California Institute of Technology, which manages the Jet Propulsion Laboratory, is a major recipient of funds under letter of credit procedures. Detailed monitoring and accountability records are maintained. Monitoring includes audits by the Defense Contract Audit Agency (DCAA) and NASA's Office Of Inspector General. In FY 2003, NASA recorded drawdowns as disbursements rather than as an advance.

### **Prepaid Expenses**

Payments in advance of receipt of goods or services are recorded as prepaid expenses at the time of payment and recognized as expenses when related goods or services are received.

### **Materials and Supplies**

Materials held by Centers and contractors that are repetitively procured, stored and issued on the basis of demand are considered Materials and Supplies. Certain NASA contractors' inventory management systems do not distinguish between items that should be classified as materials and those that should be classified as depreciable property. In FY 2002, NASA estimated the relative amounts of materials and property accounted for in these systems using sampling techniques and statistical simulation models. During FY 2003, NASA revised its methodology and reclassified, as property, all materials \$100,000 or greater, in support of a large scale asset (i.e. Space Shuttle and the International Space Station).

### **Property, Plant and Equipment**

NASA-owned property, plant, and equipment are held by the Agency and its contractors and grantees. Property with a unit cost of \$100,000 or more and a useful life of two years or more is capitalized; all other property is expensed when purchased. Capitalized costs include all costs incurred by NASA to bring the property to a form and location suitable for its intended use. Under provisions of the Federal Acquisition Regulation (FAR), contractors are responsible for control over accountability for Government-owned property in their possession. NASA's contractors and grantees report on NASA property in their custody annually.

For FY 2003, the accounting treatment for capitalization of Assets in Space was changed. In previous years, NASA expensed certain components of these types of assets due to the fact that these were immaterial. NASA policy was changed to capitalize all applicable costs of these assets as Work in Progress (WIP) and then expense the cost in the year the assets become operational

**National Aeronautics and Space Administration  
Notes to Financial Statements**

Capitalized costs for internally developed software included the full costs (direct and indirect) incurred during the software development phase only. For purchased software, capitalized costs include amounts paid to vendors for the software and material internal costs incurred by the Agency to implement and make the software ready for use through acceptance testing. When NASA purchases software as part of a package of products and services (for example: training, maintenance, data conversion, reengineering, site licenses, and rights to future upgrades and enhancements), capitalized and noncapitalizable costs of the package are allocated among individual elements on the basis of a reasonable estimate of their relative fair market values. Costs that are not susceptible to allocation between maintenance and relatively minor enhancements are expensed. During FY 2003, NASA changed its capitalization threshold for internal use software from \$100,000 to \$1,000,000, in order to coincide with the current practices of other Federal agencies. As a result, internal use software under development in the amount of \$3,012,000 as of September 30, 2002, was expensed during FY 2003.

These Financial Statements report depreciation expense using the straight-line method. Useful lives are 40 years for buildings; 15 years for other structures and facilities; 15 years for leasehold improvements, 15 years for space hardware; 7 years for special test equipment and tooling; and 5 to 20 years for other equipment depending on its nature. Useful lives for the Space Shuttle fleet range from 28 to 39 years. Useful lives for assets in space are their mission lives, ranging from 2 to 20 years.

**International Space Station**

In previous fiscal years, the asset value of the International Space Station was based on budget estimates and did not include the total costs to bring the Station to a form and location suitable for its intended use. NASA began depreciating the Station in FY 2001 when manned by the first permanent crew. Only the Station's major elements in space are depreciated; any on-ground elements are reported as work in process until launched and incorporated into the existing Station structure. In FY 2003, NASA management changed the Station's operational life from 10 years to 15 years. The depreciation was \$1.2 billion for FY 2002 and \$929 million for the fiscal year ending September 30, 2003.

**Barter Transactions**

NASA utilizes non-monetary transactions in the form of barter agreements with International Partners that govern the reciprocal exchange of goods and services. The Station international agreements are committed to minimize the exchange of funds among partners, by utilizing non-monetary transactions in the form of barter agreements with International Partners. NASA's policy is to record barter transactions based upon the fair value of the non-monetary assets transferred to or from an enterprise, whichever is more readily determinable. Fair value is determined by referring to estimated realizable values in cash transactions of the same or similar assets, quoted market prices, independent appraisals, estimated fair value market prices, independent appraisals, estimated fair values of assets or services received in exchange, and other available evidence. If fair value is not readily determinable within reasonable limits, no value is ascribed to the non-monetary transactions in accordance with Accounting Principles Bulletin No. 29, Accounting for Non-monetary Transactions. When fair value is readily determinable, barter transactions are recorded as an asset to Government-Held/Government-Owned Equipment with a corresponding liability to Liability for Assets Obtained Under Barter Agreements.

**Advances from Others**

Advances from Others represents amounts advanced by other Federal and non-Federal Entities for goods or services to be provided and are included in other liabilities in the Financial Statements.

**Liabilities Covered by Budgetary Resources**

Accounts Payable includes amounts recorded for the receipt of goods or services furnished. Additionally, NASA accrues costs and recognizes liabilities based on information provided monthly by contractors on Contractor Financial Management Reports (NASA Forms 533M and 533Q). DCAA performs independent audits to ensure reliability of reported costs and estimates. To provide further assurance, financial managers are required to test the accuracy of NF 533 generated cost accruals each month, and NASA Headquarters independently analyzes the validity of Centers' data.



### **Liabilities and Contingencies Not Covered by Budgetary Resources**

Liabilities not covered by budgetary resources include certain environmental matters, legal claims, pensions and other retirement benefits (ORB), workers' compensation, annual leave (see discussion below), and closed appropriations.

Liabilities not covered by budgetary resources consist primarily of environmental cleanup costs as required by Federal, State, and local statutes and regulations. Where up-to-date-site-specific engineering estimates for cleanup are not available, parametric models are used to estimate the total cost of cleaning up known contamination at these sites over future years. NASA estimates the total cost of environmental cleanup to be \$1.1 billion and \$1.3 billion for the Fiscal Years Ended September 30, 2003 and 2002, respectively, and recorded an unfunded liability in its financial statements for this amount. This estimate could change in the future due to identification of additional contamination, inflation, deflation, and changes in technology or applicable laws and regulations. NASA believes the estimated environmental liability could range from \$741 million to \$1.6 billion because of potential future changes to the engineering assumptions underlying the estimates. The estimate represents an amount that will be spent to remediate currently known contamination, subject to the availability of appropriated funds. Other responsible parties that may be required to contribute to the remediation funding could share this liability. NASA was appropriated \$92 million and \$ 44 million for the Fiscal Years ended September 30, 2003 and 2002, respectively, for environmental compliance and restoration. Included in the recorded liability is \$27 million and \$28 million for the Fiscal Year Ended September 30, 2003 and 2002, respectively, for cleanup of current operations.

NASA is a party in various administrative proceedings, court actions (including tort suits), and claims brought by or against it. In the opinion of management and legal counsel, the ultimate resolution of these proceedings, actions and claims will not materially affect the financial position, net cost, changes in net position, budgetary resources, or financing of NASA. Liabilities have been recorded for \$1 million and \$2 million for these matters as of September 30, 2003 and 2002, respectively.

Contingencies, related to proceedings, actions and claims where management believes, after consultation with legal counsel, it is possible, but not probable that some costs will be incurred, range from zero to \$50 million and from zero to \$49 million, as of September 30, 2003 and 2002, respectively. No balances have been recorded in the financial statements for these contingencies.

A liability for \$84 million and \$82 million was recorded, as of September 30, 2003 and September 30, 2002, respectively, for workers' compensation claims related to the Federal Employees' Compensation Act (FECA), administered by U.S. Department of Labor. The FECA provides income and medical cost protection to covered Federal civilian employees injured on the job, employees who have incurred a work-related occupational disease, and beneficiaries of employees whose death is attributable to a job-related injury or occupational disease. The FECA Program initially pays valid claims and subsequently seeks reimbursement from the Federal agencies employing the claimants. The FECA liability includes the actuarial liability of \$69 million for estimated future costs of death benefits, workers' compensation, and medical and miscellaneous costs for approved compensation cases. The present value of these estimates at the end of FY 2003 was calculated by the Department of Labor using a discount rate of 3.89 percent for FY 2003. This liability does not include the estimated future costs for claims incurred but not reported or approved as of September 30, 2003.

NASA has recorded approximately \$65 million in Accounts Payable related to closed appropriations for which there is a contractual commitment to pay. These payables will be funded from appropriations available for obligation at the time a bill is processed, in accordance with Public Law 101-510.

### **Annual, Sick, and Other Leave**

Annual leave is accrued as it is earned; the accrual is reduced as leave is taken. Each year, the balance in the accrued annual leave account is adjusted to reflect current pay rates. To the extent current or prior year appropriations are not available to fund annual leave earned but not taken, funding will be obtained from future financing sources. Sick leave and other types of non-vested leave are expensed as taken.

### **Employee Benefits**

Agency employees participate in the Civil Service Retirement System (CSRS), a defined benefit plan, or the Federal Employees Retirement System (FERS), a defined benefit and contribution plan. For CSRS employees, NASA makes contributions of 8.51 percent of pay. For FERS employees, NASA makes contributions of 10.7 percent to the defined benefit plan, contributes 1 percent of pay to a retirement saving plan (contribution plan), and matches employee contributions up to an additional 4 percent of pay. For FERS employees, NASA also contributes to employer's matching share for Social Security.

Statement of Federal Financial Accounting Standards No. 5, "Accounting for Liabilities of the Federal Government," require Government agencies to report the full cost of employee benefits (FEHB), and the Federal Employees Group Life Insurance (FEGLI) Programs. NASA used the applicable cost factors and imputed financing sources from the Office of Personnel and Management Letter For Chief Financial Officers, dated September 30, 2003, in these Financial Statements.

### **Subsequent Events**

On January 14, 2004 the President of the United States announced a new space initiative. Implementation of this initiative will require NASA to terminate some existing programs and develop new ones over the next several years. For example, the Space Shuttle, which was originally planned to continue to the year 2020, will be phased out in 2010.

NASA also announced in January 2004 that the President's FY 2005 budget would reflect the cancellation of planned servicing missions to the Hubble Space Telescope (HST).

Useful lives of assets such as the Space Shuttle and HST will be re-evaluated and depreciation expense for future years will be adjusted accordingly. Costs for future programs and missions, for example the refurbishing of the HST valued at approximately \$286 million as of September 30, 2003, currently capitalized as Work-In-Process will also be re-evaluated and adjusted accordingly.

**National Aeronautics and Space Administration**  
**Notes to Financial Statements**

**2. Fund Balance With Treasury:**

(In Thousands of Dollars)

**September 30, 2003**

Fund Balances:	Obligated	Unobligated— Available	Unobligated— Not Available	Total
Appropriated Funds	\$ 5,911,543	\$ 1,550,693	\$ 73,911	\$ 7,536,147
Trust Funds	—	—	3,616	3,616
Total	<u>\$ 5,911,543</u>	<u>\$ 1,550,693</u>	<u>\$ 77,527</u>	<u>\$ 7,539,763</u>
Clearing and Deposit Accounts				(47,257)
Total Fund Balance With Treasury				<u>\$ 7,492,506</u>

**September 30, 2002**

Fund Balances:	Obligated	Unobligated— Available	Unobligated— Not Available	Total
Appropriated Funds	\$ 5,633,289	\$ 936,119	\$ 174,474	\$ 6,743,882
Trust Funds	118	—	3,508	3,626
Other	—	—	—	
Total	<u>\$ 5,633,407</u>	<u>\$ 936,119</u>	<u>\$ 177,982</u>	<u>\$ 6,747,508</u>
Clearing and Deposit Accounts				18,986
Total Fund Balance With Treasury				<u>\$ 6,766,494</u>

Obligated balances represent the cumulative amount of obligations incurred, including accounts payable and advances from reimbursable customers, for which outlays have not yet been made. Unobligated available balances represent the amount remaining in appropriation accounts that are available for obligation in the next fiscal year. Unobligated balances not available represent the amount remaining in appropriation accounts that can be used for adjustments to previously recorded obligations. Unobligated balances not available are the result of settling obligated balances for less than what was obligated. Unobligated trust fund balances not available represent amounts that must be apportioned by the OMB before being used to incur obligations.

Clearing accounts are used for unidentified remittances presumed to be applicable to budget accounts but are being held in the clearing account because the specific appropriation account is not yet known. Deposit account balances represent amounts withheld from employees' pay for U.S. Savings Bonds and State tax withholdings that will be transferred in the next fiscal year.

**National Aeronautics and Space Administration**  
**Notes to Financial Statements**

**3. Investments:**

*(In Thousands of Dollars)*

<b>September 30, 2003</b>					
	Par Value	Amortization Method	Discounts and Premiums, Net	Interest Receivable	Net Amount Invested
Intragovernmental Non-Marketable Securities	\$ 13,942	Interest method	\$ 3,050	\$ 146	\$ 17,138
<b>September 30, 2002</b>					
	Par Value	Amortization Method	Discounts and Premiums, Net	Interest Receivable	Net Amount Invested
Intragovernmental Non-Marketable Securities	\$ 13,825	Interest method	\$ 3,113	\$ 145	\$ 17,083

Intragovernmental securities are non-marketable Treasury securities issued by the Bureau of Public Debt.

Effective interest rates range from 0.876 percent to 5.262 percent and from 1.56 percent to 6.60 percent for the Fiscal Year ended September 30, 2003 and September 30, 2002, respectively.

The interest method was used to amortize discounts and premiums.

**4. Accounts Receivable, Net:**

*(In Thousands of Dollars)*

<b>September 30, 2003</b>			
	Accounts Receivable	Allowance for Uncollectible Accounts	Net Amount Due
Intragovernmental Public	\$ 61,144	\$ -	\$ 61,144
	4,492	(885)	3,607
Total	<u>\$ 65,636</u>	<u>\$ (885)</u>	<u>\$ 64,751</u>
<b>September 30, 2002</b>			
	Accounts Receivable	Allowance for Uncollectible Accounts	Net Amount Due
Intragovernmental Public	\$ 53,544	\$ -	\$ 53,544
	10,023	(1,051)	8,972
Total	<u>\$ 63,567</u>	<u>\$ (1,051)</u>	<u>\$ 62,516</u>

**National Aeronautics and Space Administration**  
**Notes to Financial Statements**

**5. Operating Materials and Supplies:**

(In Thousands of Dollars)

	<b>September 30, 2003</b>	
	<b>2003</b>	<b>2002</b>
Operating Materials and Supplies, Held for Use	\$ 2,676,245	\$ 2,204,773
Operating Materials and Supplies, Held in Reserve for Future Use	3,232	3,291
<b>Total</b>	<b>\$ 2,679,477</b>	<b>\$ 2,208,064</b>

“Operating Materials and Supplies, Held for Use” are tangible personal property held by NASA and its contractors to be used for fabricating and maintaining NASA assets. They will be consumed in normal operations. Operating “Materials and Supplies, Held in Reserve for Future Use” are tangible personal property held by NASA for emergencies for which there is no normal recurring demand but that must be immediately available to preclude delay, which might result in loss, damage or destruction of Government property, danger to life or welfare of personnel, or substantial financial loss to the Government due to an interruption of operations. All materials are valued using historical costs, or other valuation methods that approximate historical cost. NASA Centers and contractors are responsible for continually reviewing materials and supplies to identify items no longer needed for operational purposes or that need to be replaced. Excess, obsolete, and unserviceable items have been removed from these amounts. There are no restrictions on these items.

For the year ended September 30, 2002 \$527,521 was written-off as excess, obsolete and unserviceable inventory. For the year ended September 30, 2003 no amounts were written-off.

**6. Property, Plant, and Equipment, Net:**

(In Thousands of Dollars)

	<b>September 30, 2003</b>		
	Cost	Accumulated Depreciation	Net Asset Value
Government-owned/Government-held:			
Land	\$ 115,132	\$ -	\$ 115,132
Structures, Facilities, and Leasehold Improvements	5,575,501	(3,852,518)	\$ 1,722,983
Assets in Space	36,003,528	(18,105,281)	\$ 17,898,247
Equipment	1,926,673	(1,278,218)	\$ 648,455
Capitalized Leases (Note 10)	273	(59)	\$ 214
Internal Use Software and Development	22,600	(4,473)	\$ 18,127
Work-in-Process (WIP)	8,119,053	-	\$ 8,119,053
<b>Total</b>	<b>\$ 51,762,760</b>	<b>\$ (23,240,549)</b>	<b>\$ 28,522,211</b>
Government-owned/Contractor-held:			
Land	\$ 8,076	\$ -	\$ 8,076
Structures, Facilities, and Leasehold Improvements	755,344	(502,054)	\$ 253,290
Equipment	9,940,395	(7,408,231)	\$ 2,532,164
Work-in-Process	5,308,795	-	\$ 5,308,795
<b>Total</b>	<b>\$ 16,012,610</b>	<b>\$ (7,910,285)</b>	<b>\$ 8,102,325</b>
<b>Total Property, Plant, and Equipment</b>	<b>\$ 67,775,370</b>	<b>\$ (31,150,834)</b>	<b>\$ 36,624,536</b>

**National Aeronautics and Space Administration**  
**Notes to Financial Statements**

**6. Property, Plant, and Equipment, Net:** (Continued)  
*(In Thousands of Dollars)*

	<b>September 30, 2002</b>		
	Cost	Accumulated Depreciation	Net Asset Value
Government-owned/Government-held:			
Land	\$ 115,132	\$ -	\$ 115,132
Structures, Facilities, and Leasehold Improvements	5,501,471	(3,681,992)	1,819,479
Assets in Space	34,360,780	(17,347,280)	17,013,500
Equipment	1,843,468	(1,250,328)	593,140
Capitalized Leases (Note 10)	3,088	(666)	2,422
Internal Use Software and Development	16,549	(1,819)	14,730
Work-in-Process (WIP)	4,561,011	-	4,561,011
Total	<u>\$ 46,401,499</u>	<u>\$ (22,282,085)</u>	<u>\$ 24,119,414</u>
Government-owned/Contractor-held:			
Land	\$ 8,076	\$ -	\$ 8,076
Structures, Facilities, and Leasehold Improvements	723,453	(468,288)	255,165
Equipment	11,356,434	(8,096,532)	3,259,902
Work-in-Process	7,330,736	-	7,330,736
Total	<u>\$ 19,418,699</u>	<u>\$ (8,564,820)</u>	<u>\$ 10,853,879</u>
Total Property, Plant, and Equipment	<u>\$ 65,820,198</u>	<u>\$ (30,846,905)</u>	<u>\$ 34,973,293</u>

Assets in Space are various spacecraft that operate above the atmosphere for exploration purposes. Equipment includes special tooling, special test equipment, and Agency-peculiar property, such as the Space Shuttle and other configurations of spacecraft: engines, unlaunched satellites, rockets, and other scientific components unique to NASA space programs. Structures, Facilities, and Leasehold Improvements includes buildings with collateral equipment, and capital improvements, such as airfields, power distribution systems, flood control, utility systems, roads, and bridges. NASA also has use of certain properties at no cost. These properties include land at the Kennedy Space Center withdrawn from the public domain and land and facilities at the Marshall Space Flight Center under a no cost, 99-year lease with the U.S. Department of the Army. Work-in-Process is the cost incurred for property, plant, and equipment items not yet completed. Work-in-Process includes equipment and facilities that are being constructed. WIP includes the fabrication of assets that may or may not be capitalized once completed and operational. If it is determined to not meet capitalization criteria (i.e. less than 2 year useful life) the project will be expensed to the Statement of Net Cost to match outputs to inputs.

NASA has International Space Station (ISS) bartering agreements with the European Space Agency, the Italian Space Agency, the National Space Agency of Japan, the Canadian Space Agency, and the Brazilian Space Agency. NASA barter with these other space agencies to obtain ISS hardware elements in exchange for providing goods and services such as Space Shuttle transportation and a share of NASA's ISS utilization rights. The intergovernmental agreements state that the parties will seek to minimize the exchange of funds in the cooperative program, including the use of barter to provide goods and services. As of September 30, 2003, NASA has received various assets from these parties in exchange for future services. However, due to the fact that fair value is indeterminable, no value was ascribed to these transactions in accordance with APB No. 29. Under all agreements to date, NASA's ISS Program's International Partners Office expects that NASA will eventually receive future NASA-required elements as well with no exchange of funds.

NASA reports the physical existence (in terms of physical units) of heritage assets as part of the required supplemental stewardship information.



**National Aeronautics and Space Administration**  
**Notes to Financial Statements**

**7. Other Liabilities:**

(In Thousands of Dollars)

	<b>September 30, 2003</b>		
	Current	Non-Current	Total
<b>Intragovernmental Liabilities:</b>			
Advances From Others	\$ 50,242	\$ -	\$ 50,242
Workers' Compensation	8,470	6,854	15,324
Accrued Funded Payroll	6,362	-	6,362
Accounts Payable for Closed Appropriations	-	32	32
Liability for Deposit and Clearing Funds	6	-	6
Custodial Liability	2,056	-	2,056
Lease Liabilities	-	-	-
Total Intragovernmental	<u>67,136</u>	<u>6,886</u>	<u>74,022</u>
<b>Liabilities From the Public:</b>			
Unfunded Annual Leave	-	158,627	158,627
Accrued Funded Payroll	61,623	-	61,623
Actuarial FECA Liability	-	69,446	69,446
Accounts Payable for Closed Appropriations	1,649	31,328	32,977
Advances From Others	142,294	-	142,294
Contract Holdbacks	1,680	-	1,680
Custodial Liability	280	-	280
Other Accrued Liabilities	38,029	-	38,029
Contingent Liabilities	-	1,023	1,023
Lease Liabilities	100	-	100
Liability for Deposit and Clearing Funds	(47,454)	-	(47,454)
Total From the Public	<u>198,201</u>	<u>260,424</u>	<u>458,625</u>
Total Other Liabilities	<u>\$ 265,337</u>	<u>\$ 267,310</u>	<u>\$ 532,647</u>
	<b>September 30, 2002</b>		
	Current	Non-Current	Total
<b>Intragovernmental Liabilities:</b>			
Advances From Others	\$ 186,419	\$ -	\$ 186,419
Workers' Compensation	7,245	8,470	15,715
Accrued Funded Payroll	13,885	-	13,885
Accounts Payable for Closed Appropriations	-	2,872	2,872
Liability for Deposit and Clearing Funds	12,652	-	12,652
Custodial Liability	900	-	900
Lease Liabilities	112	158	270
Total Intragovernmental	<u>221,213</u>	<u>11,500</u>	<u>232,713</u>
<b>Liabilities From the Public:</b>			
Unfunded Annual Leave	-	145,638	145,638
Accrued Funded Payroll	109,151	-	109,151
Actuarial FECA Liability	-	67,280	67,280
Accounts Payable for Closed Appropriations	2,251	43,141	45,392
Advances From Others	38,283	-	38,283
Contract Holdbacks	1,782	-	1,782
Custodial Liability	2,785	-	2,785
Other Accrued Liabilities	-	-	-
Contingent Liabilities	-	1,504	1,504
Lease Liabilities	233	96	329
Liability for Deposit and Clearing Funds	6,336	-	6,336
Total From the Public	<u>160,821</u>	<u>257,659</u>	<u>418,480</u>
Total Other Liabilities	<u>\$ 382,034</u>	<u>\$ 269,159</u>	<u>\$ 651,193</u>

**National Aeronautics and Space Administration**  
**Notes to Financial Statements**

**8. Liabilities Not Covered by Budgetary Resources:**

(In Thousands of Dollars)

	<b>September 30, 2003</b>		
	Current	Non-Current	Total
Intragovernmental Liabilities:			
Workers' Compensation	\$ 8,470	\$ 6,854	\$ 15,324
Accounts Payable for Closed Appropriations	-	32	32
Total Intragovernmental	<u>8,470</u>	<u>6,886</u>	<u>15,356</u>
From the Public:			
Environmental Cleanup Costs	-	1,096,109	1,096,109
Unfunded Annual Leave	-	158,627	158,627
Actuarial FECA Liability	-	69,446	69,446
Accounts Payable for Closed Appropriations	1,649	31,328	32,977
Contingent Liabilities	-	1,023	1,023
Total From the Public	<u>1,649</u>	<u>1,356,533</u>	<u>1,358,182</u>
Total Liabilities Not Covered by Budgetary Resources	<u>\$ 10,119</u>	<u>\$ 1,363,419</u>	<u>\$ 1,373,538</u>

	<b>September 30, 2002</b>		
	Current	Non-Current	Total
Intragovernmental Liabilities:			
Workers' Compensation	\$ 7,245	\$ 8,470	\$ 15,715
Accounts Payable for Closed Appropriations	-	2,872	2,872
Total Intragovernmental	<u>7,245</u>	<u>11,342</u>	<u>18,587</u>
From the Public:			
Environmental Cleanup Costs	-	1,271,937	1,271,937
Unfunded Annual Leave	-	145,638	145,638
Actuarial FECA Liability	-	67,280	67,280
Accounts Payable for Closed Appropriations	2,251	43,141	45,392
Contingent Liabilities	-	1,504	1,504
Total From the Public	<u>2,251</u>	<u>1,529,500</u>	<u>1,531,751</u>
Total Liabilities Not Covered by Budgetary Resources	<u>\$ 9,496</u>	<u>\$ 1,540,842</u>	<u>\$ 1,550,338</u>

See Note 1 for further discussion of liabilities not covered by budgetary resources.

**9. Non-Entity Assets:**

(In Thousands of Dollars)

Asset	<b>September 30, 2003</b>		
	Intragovernmental	Due from the Public	Total Non-Entity Assets
Accounts Receivable, Net	<u>\$ 2,056</u>	<u>\$ 3,229</u>	<u>\$ 5,285</u>
Asset	<b>September 30, 2002</b>		
	Intragovernmental	Due from the Public	Total Non-Entity Assets
Accounts Receivable, Net	<u>\$ 230</u>	<u>\$ 3,455</u>	<u>\$ 3,685</u>

Accounts receivable related to closed appropriations, which will be deposited in miscellaneous receipts, are included in Non-Entity Assets. These amounts represent NASA's custodial activity and are not separately identified on the Balance Sheet as the amounts are immaterial.

**National Aeronautics and Space Administration**  
**Notes to Financial Statements**

**10. Leases:**

(In Thousands of Dollars)

	<b>As of September 30</b>	
	<b>2003</b>	<b>2002</b>
Entity as Lessee:		
Capital Leases:		
Summary of Assets Under Capital Lease:		
Equipment	\$ 273	\$ 3,088
Accumulated Amortization	\$ (173)	\$ (2,452)
	<u>\$ 100</u>	<u>\$ 636</u>

Capital leases consist of assorted types of machinery with non-cancelable terms longer than one year, a fair market value of \$100,000 or more, a useful life of two years or more, and agreement terms equivalent to an installment purchase.

Future Minimum Lease Payments:

Fiscal Year	
2004	\$ 104
2005	0
2006	-
2007 and after	-
Future Lease Payments	104
Less: Imputed Interest	(4)
Net Capital Lease Liability	<u>\$ 100</u>

Lease liabilities covered by budgetary resources	\$ 100
Lease liabilities not covered by budgetary resources	-
Total Lease liabilities	<u>\$ 100</u>

Operating Leases—

NASA's FY 2003 operating leases are for an airplane hangar, warehouse storage, copiers and land.

Future Minimum Lease Payments:

Fiscal Year	Land and Buildings	Equipment	Total
2004	\$ 389	\$ 248	\$ 637
2005	175	-	175
2006	-	-	-
2007 and after	-	-	-
Total Future Lease Payments	<u>\$ 564</u>	<u>\$ 248</u>	<u>\$ 812</u>

Entity as Lessor:

Operating Leases—

NASA leases and allows use of its land and facilities by the public and other Government agencies for a fee.

Future Projected Receipts:

Fiscal Year	Land and Buildings
2004	\$ 158
2005	\$ 151
2006	73
2007	65
2008 and after	839
Total Future Operating Lease Receivables	<u>\$ 1,286</u>

**11. Gross Cost and Earned Revenue By Budget Functional Classification:**

*(In Thousands of Dollars)*

**For the Period Ending September 30, 2003**

Functional Classification	Gross Cost	Earned Revenue	Net Cost
General Science, Space, and Technology	\$ 12,537,907	\$ (731,216)	\$ 11,806,691
Transportation	169,562	(606)	168,956
<b>Total</b>	<b>\$ 12,707,469</b>	<b>\$ (731,822)</b>	<b>\$ 11,975,647</b>

**For the Period Ending September 30, 2002**

Functional Classification	Gross Cost	Earned Revenue	Net Cost
General Science, Space, and Technology	\$ 14,877,216	\$ (654,876)	\$ 14,222,340
Transportation	191,119	(76,004)	115,115
Costs Not Assigned to Programs	216	-	216
<b>Total</b>	<b>\$ 15,068,551</b>	<b>\$ (730,880)</b>	<b>\$ 14,337,671</b>

**12. Statement of Net Costs**

The Statement of Net Cost recognizes post-employment benefit expenses of \$130 million and \$108 million for fiscal years 2003 and 2002, respectively.

The expense to Office of Personnel Management represents NASA's share of the current and estimated future outlays for employee pensions, life and health insurance. Additionally, the statement includes 630 thousand and \$104 million for fiscal year 2003 and 2002, respectively, for the Judgment Fund. The expense attributable to the Treasury's Judgment Fund represents amounts paid directly from the Judgment Fund.

**13. Statement of Budgetary Resources**

*(In Thousands of Dollars)*

Apportionment Categories of Obligations Incurred:

The amounts of direct and reimbursable obligations incurred against amounts apportioned under Categories A and B are displayed below:

	Direct	Reimbursable	Total
2003	\$ 14,859,449	\$ 778,297	\$ 15,637,746
2002	\$ 14,789,386	\$ 730,098	\$ 15,519,484

The amounts of obligations incurred against amounts apportioned under Category A are \$1,000.

The Budget of the United States Government with actual numbers for FY 2003 has not been published as of January 9, 2004. The document will be published at a later date. Once published the document may be found at the Office of Management and Budget website, [www.whitehouse.gov/omb](http://www.whitehouse.gov/omb).

**National Aeronautics and Space Administration**  
**Notes to Financial Statements**

**14. Net Cost by Program**

*(In Thousands of Dollars)*

<b>Program/Operating Expenses by Enterprise:</b>	<b>2003</b>	<b>2002</b>
<b>Human Exploration and Development of Space:</b>		
Space Shuttle	\$ 3,008,611	\$ 3,232,011
Space Station	1,510,049	1,727,749
Space Operations	69,342	369,737
Investment and Support	145,031	465,881
Payload Utilization and Operations	217,999	180,888
Safety, Reliability and Quality Assurance		69,868
Mission Communications Services	(46,608)	253,654
Space Communications Services	295,008	(18,363)
U.S./Russian Cooperative	52	(2)
Total Human Exploration and Development of Space	5,199,484	6,281,423
<b>Space Science:</b>		
Space Science	2,757,024	2,824,792
Planetary Exploration	-	(232)
Total Space Science	2,757,024	2,824,560
<b>Earth Science:</b>		
Earth Science	1,268,837	1,488,187
<b>Biological and Physical Research:</b>		
Biological and Physical Research	1,330,037	720,183
<b>Aerospace Technology:</b>		
Aerospace Technology	1,083,956	2,398,468
Advanced Space Transportation	5,533	16,049
Commercial Technology	107,880	354,717
Total Aerospace Technology	1,197,369	2,769,234
<b>Education: (formerly Academic Programs)</b>		
Education	168,956	115,115
Total Enterprise Program Costs	11,921,707	14,198,702
<b>Costs Not Assigned to Enterprises:</b>		
Other Programs	53,940	138,969
<b>Total Costs Not Assigned to Enterprises</b>	<b>53,940</b>	<b>138,969</b>
<b>Net Cost of Operations</b>	<b>\$ 11,975,647</b>	<b>\$ 14,337,671</b>

Depreciation expenses in the amount of \$3,348,775 and \$3,694,194 for fiscal years 2003 and 2002, respectively, have been allocated to the applicable programs based on percentage of current year labor hours per project. Capitalized costs in the amount of \$5,530,942 and \$3,621,434 for fiscal years 2003 and 2002, respectively, have been allocated to the applicable programs based on percentage of current year labor hours per project.

**15. Explanation of the Relationship Between Liabilities Not Covered by Budgetary Resources on the Balance Sheet and the Change in Components Requiring or Generating Resources in Future Periods**

*(In Thousands of Dollars)*

Liabilities Not Covered by Budgetary Resources of \$1,373,538 and \$1,550,338 for fiscal year 2003 and fiscal year 2002, respectively, represent NASA's environmental liability, FECA liability to DOL and employees, contingent liabilities, accounts payable for closed appropriations and leave earned but not taken (See Note 8, Liabilities Not Covered by Budgetary Resources). Only a portion of these liabilities will require or generate resources in future periods.

**National Aeronautics and Space Administration  
Notes to Financial Statements**

Federal agencies are required to classify and report heritage assets, in accordance with the requirements of SFFAS No. 8, "Supplementary Stewardship Reporting."

Heritage Assets are property, plant, and equipment that possess one or more of the following characteristics: historical or natural significance; cultural, educational, or aesthetic value; or significant architectural characteristics.

Since the cost of heritage assets is usually not relevant or determinable, NASA does not attempt to value them or to establish minimum value thresholds for designation of property, plant, or equipment as heritage assets. The useful lives of heritage assets are not reasonably estimable for depreciation purposes.

Since the most relevant information about heritage assets is their existence, they are reported in terms of physical units, as follows:

	2002	Additions	Withdrawals	2003
Buildings and Structures	37	3	-	40
Air and Space displays and artifacts	520	27	7	540
Miscellaneous items	1,024	14	21	1,017
Total Heritage Assets	1,581	44	28	1,597

Heritage Assets were generally acquired through construction by NASA or its contractors, and are expected to remain in this category, except where there is legal authority for transfer or sale. Heritage assets are generally in fair condition, suitable only for display.

Many of the buildings and structures are designated as National Historic Landmarks. Numerous air and spacecraft and related components are on display at various locations to enhance public understanding of NASA programs. NASA eliminated their cost from its property records when they were designated as heritage assets. A portion of the amount reported for deferred maintenance is for heritage assets.

In accordance with SFFAS No. 8, as amended, heritage assets whose predominant uses are, in general, Government operations are considered "multi-use" heritage assets. Such assets are accounted for as general property, plant, and equipment and capitalized and depreciated in the same manner as other general property, plant, and equipment. NASA has 18 buildings and structures considered to be "multi-use" heritage assets. The values of these assets are included in the property, plant, and equipment values shown in the Financial Statements.

For more than 30 years, the NASA Art Program, an important heritage asset, has documented America's major accomplishments in aeronautics and space. During that time, more than 200 artists have generously contributed their time and talent to record their impressions of the U.S. aerospace program in paintings, drawings, and other media. Not only do these art works provide a historic record of NASA projects, they give the public a new and fuller understanding of advancements in aerospace. Artists are, in fact, given a special view of NASA through the "back door." Some have witnessed astronauts in training or scientists at work. The art collection, as a whole, depicts a wide range of subjects, from Space Shuttle launches to aeronautics research, Hubble Space Telescope and even virtual reality.

Artists commissioned by NASA receive a small honorarium in exchange for donating a minimum of one piece to the NASA archive, which now numbers more than 700 works of art. In addition more than 2,000 works have been donated to the National Air and Space Museum.



**National Aeronautics and Space Administration**  
**Required Supplementary Stewardship Information**  
**Stewardship Investments: Research and Development**  
**For the Fiscal Years Ended September 30, 2003**

(In Thousands of Dollars)

**Research and Development Expenses by Enterprise by Programs/Applications**

	2003	2002	2001 (Restated)	2000	1999
<b>Human Exploration and Development of Space (HEDS)</b>					
<b>Space Station (a)</b>					
Basic Research	\$ -	\$ -	\$ -	\$ -	\$ -
Applied Research	-	-	-	-	99,678
Development	-	-	-	-	2,456,172
Subtotal	\$ -	\$ -	\$ -	\$ -	\$ 2,555,850
<b>Space Operations</b>					
Basic Research	\$ 69,342	\$ 369,737	\$ 147,869	\$ 457,582	\$ -
Applied Research	-	-	92,419	-	-
Development	-	-	129,386	-	430,503
Subtotal	\$ 69,342	\$ 369,737	\$ 369,674	\$ 457,582	\$ 430,503
<b>Investment and Support (b)</b>					
Basic Research	\$ -	\$ -	\$ -	\$ -	\$ -
Applied Research	-	27,453	164,241	-	-
Development	-	-	-	-	-
Subtotal	\$ -	\$ 27,453	\$ 164,241	\$ -	\$ -
<b>Payload Utilization and Operations</b>					
Basic Research	\$ -	\$ -	\$ -	\$ -	\$ -
Applied Research	217,999	180,888	153,324	419,452	375,970
Development	\$ -	\$ -	\$ -	\$ -	\$ -
Subtotal	\$ 217,999	\$ 180,888	\$ 153,324	\$ 419,452	\$ 375,970
<b>HEDS Total</b>	<b>\$ 287,341</b>	<b>\$ 578,078</b>	<b>\$ 687,239</b>	<b>\$ 877,034</b>	<b>\$ 3,362,323</b>
<b>Space Science (SSE)</b>					
<b>Space Science</b>					
Basic Research	\$ 995,286	\$ 988,677	\$ 581,163	\$ 818,718	\$ 747,763
Applied Research	-	-	-	-	816,433
Development	1,761,738	1,836,115	1,179,937	1,625,216	979,212
Subtotal	\$ 2,757,024	\$ 2,824,792	\$ 1,761,100	\$ 2,443,934	\$ 2,543,408
<b>Planetary Exploration</b>					
Basic Research	\$ -	\$ -	\$ -	\$ 11,152	\$ 10,049
Applied Research	-	-	-	-	10,972
Development	-	-	-	22,137	13,160
Subtotal	\$ -	\$ -	\$ -	\$ 33,289	\$ 34,181
<b>SSE Total</b>	<b>\$ 2,757,024</b>	<b>\$ 2,824,792</b>	<b>\$ 1,761,100</b>	<b>\$ 2,477,223</b>	<b>\$ 2,577,589</b>
<b>Earth Science (ESE)</b>					
Basic Research	\$ 629,343	\$ 544,676	\$ 255,678	\$ 494,956	\$ 358,782
Applied Research	71,055	105,661	55,161	97,018	130,625
Development	568,439	837,850	434,577	1,052,397	1,252,260
<b>ESE Total</b>	<b>\$ 1,268,837</b>	<b>\$ 1,488,187</b>	<b>\$ 745,416</b>	<b>\$ 1,644,371</b>	<b>\$ 1,741,667</b>
<b>Biological and Physical Research (BPR) (c)</b>					
Basic Research	\$ 396,351	\$ 209,573	\$ 69,603	\$ 107,951	\$ 162,858
Applied Research	804,673	415,546	112,221	166,746	119,548
Development	129,013	95,064	32,338	46,586	14,239
<b>BPR Total</b>	<b>\$ 1,330,037</b>	<b>\$ 720,183</b>	<b>\$ 214,162</b>	<b>\$ 321,283</b>	<b>\$ 296,645</b>

**National Aeronautics and Space Administration  
Required Supplementary Stewardship Information  
Stewardship Investments: Research and Development  
For the Fiscal Years Ended September 30, 2003**

(In Thousands of Dollars)

**Research and Development Expenses by Enterprise by Programs/Applications (continued):**

	2003	2002	2001 (Restated)	2000	1999
<b>Aerospace Technology (AT)</b>					
<b>Aerospace Technology</b>					
Basic Research	\$ -	\$ -	\$ -	\$ 144,053	\$ 356,546
Applied Research	1,083,956	2,398,468	1,039,635	906,288	910,027
Development	-	-	-	83,937	20,595
Subtotal	\$ 1,083,956	\$ 2,398,468	\$ 1,039,635	\$ 1,134,278	\$ 1,287,168
<b>Advanced Space Transportation</b>					
Basic Research	\$ -	\$ -	\$ -	\$ -	\$ -
Applied Research	5,533	16,049	83,971	512,409	569,775
Development	-	-	-	-	-
Subtotal	\$ 5,533	\$ 16,049	\$ 83,971	\$ 512,409	\$ 569,775
<b>Commercial Technology</b>					
Basic Research	\$ 3,776	\$ -	\$ -	\$ -	\$ 99,080
Applied Research	104,105	342,302	127,697	171,591	45,341
Development	-	12,415	-	6,224	23,510
Subtotal	\$ 107,881	\$ 354,717	\$ 127,697	\$ 177,815	\$ 167,931
<b>AT Total</b>	<b>\$ 1,197,370</b>	<b>\$ 2,769,234</b>	<b>\$ 1,251,303</b>	<b>\$ 1,824,502</b>	<b>\$ 2,024,874</b>
<b>Education (formerly Academic Programs)</b>					
Basic Research	\$ 121,649	\$ 81,271	\$ 97,112	\$ 71,504	\$ 93,339
Applied Research	47,307	33,844	42,017	39,873	19,657
Development	-	-	-	-	13,823
<b>Education Total</b>	<b>\$ 168,956</b>	<b>\$ 115,115</b>	<b>\$ 139,129</b>	<b>\$ 111,377</b>	<b>\$ 126,819</b>
<b>Total Research and Development Expenses by Program</b>	<b>\$ 7,009,565</b>	<b>\$ 8,495,589</b>	<b>\$ 4,798,349</b>	<b>\$ 7,255,790</b>	<b>\$ 10,129,917</b>
<b>Non-Research and Development Expenses by Enterprise by Programs/Applications:</b>					
<b>Human Exploration and Development of Space (HEDS)</b>					
Space Shuttle	\$ 3,008,610	\$ 3,232,011	\$ 2,100,835	\$ 3,303,230	\$ 3,285,407
Space Station	1,510,049	1,727,749	(1,253,026)	2,754,089	-
Investment and Support	145,031	438,428	-	-	-
Space Communication Services	295,008	(18,363)	25,776	-	184,978
Safety, Reliability and Quality Assurance	-	69,868	40,037	-	-
Mission Communication Services	(46,608)	253,654	32,199	-	-
U.S. Russian Cooperative	52	(2)	208	22,124	151,396
<b>HEDS Total</b>	<b>\$ 4,912,142</b>	<b>\$ 5,703,345</b>	<b>\$ 946,029</b>	<b>\$ 6,079,443</b>	<b>\$ 3,621,781</b>
<b>Space Science (SSE)</b>					
Planetary Exploration	-	(232)	787	-	-
<b>SSE Total</b>	<b>-</b>	<b>(232)</b>	<b>787</b>	<b>-</b>	<b>-</b>
<b>Other Programs</b>	<b>53,940</b>	<b>138,969</b>	<b>131,737</b>	<b>1,271</b>	<b>832</b>
<b>Reimbursable Expenses</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>737,498</b>	<b>817,810</b>
<b>Total Non-Research and Development Expenses by Program</b>	<b>\$ 4,966,082</b>	<b>\$ 5,842,082</b>	<b>\$ 1,078,553</b>	<b>\$ 6,818,212</b>	<b>\$ 4,440,423</b>
<b>Total Program Expenses</b>	<b>\$11,975,647</b>	<b>\$14,337,671</b>	<b>\$ 5,876,902</b>	<b>\$14,074,002</b>	<b>\$14,570,340</b>

NASA makes substantial research and development investments for the benefit of the United States. These amounts are expensed as incurred in determining the net cost of operations.

**National Aeronautics and Space Administration  
Required Supplementary Stewardship Information  
Stewardship Investments: Research and Development  
For the Fiscal Years Ended September 30, 2003**

NASA's research and development programs include activities to extend our knowledge of the Earth, its space environment, and the universe, and to invest in new aeronautics and advanced space transportation technologies that support the development and application of technologies critical to the economic, scientific, and technical competitiveness of the United States.

Investment in research and development refers to those expenses incurred to support the search for new or refined knowledge and ideas and for the application or use of such knowledge and ideas for the development of new or improved products and processes with the expectation of maintaining or increasing national economic productive capacity or yielding other future benefits. Research and development is composed of:

**Basic research:** Systematic study to gain knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind;

**Applied research:** Systematic study to gain knowledge or understanding necessary for determining the means by which a recognized and specific need may be met; and

**Development:** Systematic use of the knowledge and understanding gained from research for the production of useful materials, devices, systems, or methods, including the design and development of prototypes and processes.

The strategies and resources that NASA uses to achieve its performance goals are highlighted in the Management's Discussion & Analysis (MD&A) section of this Performance and Accountability Report. The MD&A also provides information regarding the relationship between performance outcomes and outputs to the stewardship investments outlined above. See the MD&A section titled "Highlights of Performance Goals and Results," for further details.

(a) The OMB revised its rules in Fiscal Year 2000, and no longer considered International Space Station as Investment in Research and Development, as in previous years. Therefore, in Fiscal Year 2000, Space Station became part of Non-Research and Development Expenses by Program.

(b) In Fiscal Year 2002, NASA's appropriation structure was realigned to incorporate the functions of the former Mission Support appropriation to Science, Aeronautics and Technology and the Human Space Flight. This realignment changed the functionality from a Research and Development program to both Research and Development and Non-Research and Development, as indicated on the schedule above.

(c) In Fiscal Year 2001, NASA established a new enterprise, Biological and Physical Research. This initiative transferred Life and Microgravity to Biological and Physical Research.

**Enterprise/Program/Application Descriptions:**

**Human Exploration and Development of Space** enterprise seeks to expand the frontiers of space and knowledge by exploring, using, and enabling the development of space.

**Space Station** International Space Station is a complex of research laboratories in low Earth orbit in which American, Russian, Canadian, European, and Japanese astronauts are conducting unique scientific and technological investigations in a micro gravity environment.

**Payload Utilization and Operations** program is the "one-stop shopping provider" for all customer carrier needs and requirements for safe and cost effective access to space via the Space Shuttle. Investment and Support Rocket Propulsion Test Support activity will continue to ensure NASA's rocket propulsion test capabilities are properly managed and maintained in World class condition.

**Space Science** seeks to chart the evolution of the universe, from origins to destiny and understand its galaxies, stars, planetary bodies, and life.

**National Aeronautics and Space Administration  
Required Supplementary Stewardship Information  
Stewardship Investments: Research and Development  
For the Fiscal Years Ended September 30, 2003**

**Enterprise/Program/ Application Descriptions** (continued):

**Biological and Physical Research** affirms NASA's commitment to the essential role biology will play in the 21st century, and supports the high-priority biological and physical sciences research needed to achieve Agency strategic objectives.

**Earth Science** develops a scientific understanding of the Earth system and its response to natural and human-induced changes to enable improved prediction of climate, weather, and natural hazards for present and future generations.

**Aerospace Technology** works to advance U.S. preeminence in aerospace research and technology. The enterprise aims to radically improve air travel, making it safer, faster, and quieter as well as more affordable, accessible, and environmentally sound.

**Advanced Space Transportation** will create a safe, affordable highway through the air and into space by improving safety, reliability, and operability, while significantly reducing the cost of space transportation systems.

**Education (formerly Academic Programs)** consists of two components, the Educational Program and the Minority University Program. Together, these two components of the Academic Programs provide guidance for the Agency's interaction with both the formal and informal education community.

**Space Shuttle** is a partially reusable space vehicle that provides several unique capabilities to the United States space program. These include retrieving payloads from orbit for reuse; servicing and repairing satellites in space; safely transporting humans to and from space; launching ISS components and providing an assembly platform in space; and operation and returning space laboratories.

**Space Communications and Data Services** supports NASA's enterprises and external customers with Space Communications and Data System services that are responsive to customer needs.

**Space Operation's** goal is to provide highly reliable and cost-effective space operations services in support of NASA's science and aeronautics programs.

NASA's **Commercial Technology Program** facilitates the transfer of NASA inventions, innovations, discoveries or improvements developed by NASA personnel or in partnership with industry/universities to the private sector.

**U.S./Russian Cooperative Program** This program includes all flight activities in support of the joint space missions involving the Space Shuttle and the Russian Mir Space Station.

**Safety, Reliability and Quality Assurance** program invests in the safety and success of NASA missions by assuring that sound and robust policies, processes, and tools for safety, reliability, quality assurance, and engineering disciplines are in place and applied throughout NASA.

The **Mission Communication Services** program, one part of NASA's Space Communications program, provides support to the breadth of NASA missions, including planetary and interplanetary missions; Human Space Flight missions; near-Earth-orbiting and spacecraft missions; suborbital and aeronautical test flight systems.

The **Planetary Exploration** program encompasses the scientific exploration of the solar system including the planets and their satellites, comets and asteroids.

**Other Programs** includes the mission of the Office of Inspector General and programs not directly supportive of a single enterprise.

**National Aeronautics and Space Administration  
Required Supplementary Information  
Combined Schedule of Budgetary Resources  
For the Fiscal Year ended September 30, 2003**

	Science, Aeronautics, and Technology	Human Space Flight	Mission Support	Other	Total
<b>Budget Authority:</b>					
Appropriation	\$ 9,207,665	\$ 6,230,900	\$ -	\$ 12,789	\$15,451,354
Net Transfers (+) or (-)	66,927	(67,052)	-	-	(125)
<b>Unobligated Balance:</b>					
Brought Forward, October 1 (+ or -)	659,339	377,404	72,421	18,756	1,127,920
<b>Spending Authority from Offsetting Collections:</b>					
Earned					
Collected	461,595	251,582	6,854	-	720,031
Receivable from Federal Sources	9,868	(4,746)	(2,505)	-	2,617
Change in unfilled orders					
Advance Received	(44,539)	16,445	(4,073)	-	(32,167)
Without Advance	(30,496)	(39,173)	5,466	-	(64,203)
<b>Recoveries of Prior Year Obligations—Actual</b>	<b>102,953</b>	<b>12,613</b>	<b>65,940</b>	<b>24</b>	<b>181,530</b>
<b>Permanently not Available:</b>					
Cancellations of Expired/No-Year Accounts	(30,734)	(3,672)	(10,784)	(543)	(45,733)
Pursuant to Public Law	(59,850)	(15,242)	-	(166)	(75,258)
<b>Total Budgetary Resources</b>	<b>\$10,342,728</b>	<b>\$ 6,759,059</b>	<b>\$ 133,319</b>	<b>\$ 30,860</b>	<b>\$17,265,966</b>
<b>Obligations Incurred:</b>					
Direct:					
Category A	\$ -	\$ -	\$ -	\$ 1,000	\$ 1,000
Category B	8,734,422	6,002,344	98,242	23,441	14,858,449
Reimbursable:					
Category B	528,963	249,366	(412)	380	778,297
<b>Unobligated Balance:</b>					
Balance Currently Available	1,039,535	496,006	14,429	723	1,550,693
Trust Funds	-	-	-	3,616	3,616
Not Available, Other	39,808	11,343	21,060	1,700	73,911
<b>Total Status of Budgetary Resources</b>	<b>\$10,342,728</b>	<b>\$ 6,759,059</b>	<b>\$ 133,319</b>	<b>\$ 30,860</b>	<b>\$17,265,966</b>
<b>Obligated Balance, net as of October 1</b>	<b>\$ 3,747,214</b>	<b>\$ 1,696,630</b>	<b>\$ 186,863</b>	<b>\$ 2,700</b>	<b>\$ 5,633,407</b>
<b>Obligated Balance, net end of period</b>					
Accounts Receivable	(43,030)	(17,654)	(416)	-	(61,100)
Unfilled Customer Orders from Federal Sources	(6,627)	15,654	479	-	9,580
Undelivered Orders	2,680,715	879,291	47,133	1,651	3,608,790
Accounts Payable	1,522,115	800,315	30,752	1,091	2,354,273
<b>Outlays</b>					
Disbursements	\$ 8,775,101	\$ 6,301,967	\$ 137,842	\$ 24,755	\$15,239,665
Collections	(417,056)	(268,028)	(2,780)	-	(687,864)
Less: Offsetting Receipts	-	-	-	6	6
<b>Net Outlays</b>	<b>\$ 8,358,045</b>	<b>\$ 6,033,939</b>	<b>\$ 135,062</b>	<b>\$ 24,749</b>	<b>\$14,551,795</b>

**National Aeronautics and Space Administration  
Required Supplementary Information  
Combined Schedule of Budgetary Resources  
For the Fiscal Year Ended September 30, 2002**

(In Thousands of Dollars)

	Science, Aeronautics, and Technology	Human Space Flight	Mission Support	Other	Total
<b>Budget Authority:</b>					
Appropriation	\$ 7,889,600	\$ 6,988,400	\$ -	\$ 24,826	\$14,902,826
Net Transfers (+) or (-)	209,968	(209,968)	-	-	-
<b>Unobligated Balance:</b>					
Brought Forward, October 1 (+ or -)	509,360	175,095	165,434	24,052	873,941
Net Transfers, Balances, Actual (+ or -)	-	437	9,721	(10,158)	-
<b>Spending Authority from Offsetting Collections:</b>					
Earned					
Collected	491,484	239,369	28,579	68	759,500
Receivable from Federal Sources	(4,073)	2,985	(16,072)	-	(17,160)
Change in unfilled orders					
Advance Received	106,537	32,141	(7,176)	-	131,502
Without Advance from Federal Sources	(80,038)	22,877	(1,449)	-	(58,610)
<b>Recoveries of Prior Year Obligations—Actual</b>	<b>47,640</b>	<b>39,901</b>	<b>14,804</b>	<b>8</b>	<b>102,353</b>
<b>Permanently not Available:</b>					
Cancellations of Expired/No-Year Accounts	(25,637)	(6,694)	(4,257)	(347)	(36,935)
Pursuant to Public Law	(4,576)	(5,437)	-	-	(10,013)
<b>Total Budgetary Resources</b>	<b>\$ 9,140,265</b>	<b>\$ 7,279,106</b>	<b>\$ 189,584</b>	<b>\$ 38,449</b>	<b>\$16,647,404</b>
<b>Obligations Incurred:</b>					
Direct:					
Category A	\$ -	\$ -	\$ -	\$ 1,000	\$ 1,000
Category B	8,030,845	6,624,197	114,651	18,693	14,788,386
Reimbursable:					
Category B	450,081	277,504	2,513	-	730,098
<b>Unobligated Balance:</b>					
Balance Currently Available	528,454	359,060	48,213	392	936,119
Trust Funds	-	-	-	-	-
Not Available, Other	130,885	18,345	24,207	18,364	191,801
<b>Total Status of Budgetary Resources</b>	<b>\$ 9,140,265</b>	<b>\$ 7,279,106</b>	<b>\$ 189,584</b>	<b>\$ 38,449</b>	<b>\$16,647,404</b>
<b>Obligated Balance, net as of October 1</b>	<b>\$ 3,359,961</b>	<b>\$ 1,468,499</b>	<b>\$ 622,673</b>	<b>\$ 9,728</b>	<b>\$ 5,460,861</b>
<b>Obligated Balance, net end of period</b>					
Accounts Receivable	(32,773)	(22,400)	(2,921)	-	(58,094)
Unfilled Customer Orders from					
Federal Sources	(37,123)	(23,445)	5,945	-	(54,623)
Undelivered Orders	2,309,188	705,941	97,272	1,276	3,113,677
Accounts Payable	1,508,311	1,036,533	86,567	1,425	2,632,836
<b>Outlays</b>					
Disbursements	\$ 8,130,145	\$ 6,607,808	\$ 555,689	\$ 26,715	\$15,320,357
Collections	(598,021)	(271,510)	(21,403)	(68)	(891,002)
Less: Offsetting Receipts				3	3
<b>Net Outlays</b>	<b>\$ 7,532,124</b>	<b>\$ 6,336,298</b>	<b>\$ 534,286</b>	<b>\$ 26,644</b>	<b>\$14,429,352</b>

**National Aeronautics and Space Administration**  
**Required Supplementary Information**  
**Intragovernmental Transactions**  
**As of and for the Fiscal Year Ended September 30, 2003**

(In Thousands of Dollars)

**Intragovernmental Assets:**

<b>Agency</b>	<b>Fund Balance with Treasury</b>	<b>Investments</b>	<b>Accounts Receivable</b>	<b>Advances and Prepaid Expenses</b>
Treasury	\$ 7,492,506	\$ 17,138	\$ 62	\$ -
Air Force	-	-	21,890	-
Army	-	-	5,423	-
Commerce	-	-	14,380	2,581
Navy	-	-	4,203	4,438
National Science Foundation	-	-	37	380
Secretary of Defense	-	-	9,732	-
Transportation	-	-	1,693	-
Other	-	-	3,724	-
<b>Total</b>	<b>\$ 7,492,506</b>	<b>\$ 17,138</b>	<b>\$ 61,144</b>	<b>\$ 7,399</b>

**Intragovernmental Liabilities:**

<b>Agency</b>	<b>Accounts Payable</b>	<b>Closed Accounts Payable</b>	<b>Workers' Compensation</b>	<b>Liability for Deposit and Clearing Funds</b>
Air Force	\$ 17,187	\$ -	\$ -	\$ -
Army	872	-	-	-
Commerce	12,630	-	-	-
Energy	9,402	-	-	-
Labor	-	-	15,324	-
Navy	292	-	-	-
Interior	9,872	-	-	-
National Science Foundation	2,723	-	-	-
Secretary of Defense	18,979	-	-	-
Treasury	91	-	-	-
Transportation	4,605	-	-	-
Other	20,278	32	-	6
<b>Total</b>	<b>\$ 96,931</b>	<b>\$ 32</b>	<b>\$ 15,324</b>	<b>\$ 6</b>

<b>Agency</b>	<b>Advances from Others</b>	<b>Lease Liabilities</b>	<b>Accrued Funded Payroll</b>	<b>Custodial Liability</b>
Air Force	\$ 8,253	-	\$ -	\$ -
Army	888	-	-	-
Commerce	5,029	-	-	-
Energy	660	-	-	-
Office of Personnel Management	-	-	6,362	-
Interior	2,975	-	-	-
National Science Foundation	3,032	-	-	-
Navy	3,874	-	-	-
Secretary of Defense	13,140	-	-	-
Transportation	3,422	-	-	-
Treasury	45	-	-	-
Veteran's Affairs	4,334	-	-	-
Other	4,590	-	-	2,056
<b>Total</b>	<b>\$ 50,242</b>	<b>\$ -</b>	<b>\$ 6,362</b>	<b>\$ 2,056</b>



**National Aeronautics and Space Administration  
Required Supplementary Information  
Intragovernmental Transactions  
For the Year Ended September 30, 2003**

*(In Thousands of Dollars)*

**Exchange Revenue**

**Agency**

Air Force	\$	142,991
Army		19,497
Commerce		28,409
Energy		70,892
Environmental Protection Agency		1,332
National Science Foundation		17,246
Navy		6,480
Secretary of Defense		145,949
Transportation		23,789
Treasury		1,108
Interior		18,720
Agriculture		8,112
Veteran's Affairs		977
Other		172,058
<b>Total</b>	<b>\$</b>	<b>657,560</b>

**National Aeronautics and Space Administration**  
**Required Supplementary Information**  
**Intragovernmental Transactions**  
**As of and for the Fiscal Year Ended September 30, 2002**

(In Thousands of Dollars)

**Intragovernmental Assets:**

<b>Agency</b>	<b>Fund Balance with Treasury</b>	<b>Investments</b>	<b>Accounts Receivable</b>	<b>Advances and Prepaid Expenses</b>
Treasury	\$ 6,766,494	\$ 17,083	\$ 32	\$ -
Air Force	-	-	23,027	64
Army	-	-	8,689	-
Commerce	-	-	5,604	3,676
Navy	-	-	4,967	4,465
National Science Foundation	-	-	114	12,942
Secretary of Defense	-	-	4,749	92
Transportation	-	-	3,464	-
Other	-	-	2,898	35
<b>Total</b>	<b>\$ 6,766,494</b>	<b>\$ 17,083</b>	<b>\$ 53,544</b>	<b>\$ 21,274</b>

**Intragovernmental Liabilities:**

<b>Agency</b>	<b>Accounts Payable</b>	<b>Closed Accounts Payable</b>	<b>Workers' Compensation</b>	<b>Liability for Deposit and Clearing Funds</b>
Air Force	\$ 54,907	\$ 1,734	\$ -	\$ 3,628
Army	15,407	30	-	(44)
Commerce	15,518	329	-	271
Energy	14,784	10	-	324
Labor	-	-	15,715	-
Navy	19,314	452	-	190
National Science Foundation	4,430	35	-	6
Secretary of Defense	25,391	268	-	(1,198)
Treasury	9	-	-	125
Transportation	3,316	-	-	9,448
Other	28,168	14	-	(98)
<b>Total</b>	<b>\$ 181,244</b>	<b>\$ 2,872</b>	<b>\$ 15,715</b>	<b>\$ 12,652</b>

<b>Agency</b>	<b>Advances from Others</b>	<b>Lease Liabilities</b>	<b>Accrued Funded Payroll</b>	<b>Custodial Liability</b>
Air Force	\$ 54,068	\$ -	\$ -	\$ 727
Army	32,494	-	-	(305)
Commerce	82,481	-	-	225
Energy	360	-	-	40
Office of Personnel Management	-	-	13,885	-
National Space Foundation	28	-	-	178
Navy	6,720	-	-	10
Secretary of Defense	4,918	-	-	691
Transportation	1,189	-	-	150
Treasury	-	-	-	(1,227)
Veteran's Affairs	-	270	-	-
Other	4,161	-	-	411
<b>Total</b>	<b>\$ 186,419</b>	<b>\$ 270</b>	<b>\$ 13,885</b>	<b>\$ 900</b>

**National Aeronautics and Space Administration  
Required Supplementary Information  
Intragovernmental Transactions  
For the Year Ended September 30, 2002**

*(In Thousands of Dollars)*

**Exchange Revenue**

**Agency**

Air Force	\$	210,855
Army		40,094
Commerce		304,055
Energy		3,422
Environmental Protection Agency		1,320
National Space Foundation		1,780
Navy		42,015
Secretary of Defense		44,949
Transportation		12,025
Treasury		209
Interior		4,035
Agriculture		4,313
Veteran's Affairs		1,261
Other		2,019
<b>Total</b>	<b>\$</b>	<b>672,352</b>

**National Aeronautics and Space Administration  
Required Supplementary Information  
Deferred Maintenance  
For the Fiscal Year Ended September 30, 2003**

NASA has deferred maintenance only on its facilities, including structures. There is no significant deferred maintenance on other physical property, such as land, equipment, assets in space, leasehold improvements, or assets under capital lease. Contractor-held property is subject to the same considerations.

NASA developed a Deferred Maintenance parametric estimating method (DM method) in order to conduct a consistent condition assessment of its facilities. This method was developed to measure NASA's current real property asset condition and to document real property deterioration. The DM method produces both a parametric cost estimate of deferred maintenance, and a Facility Condition Index. Both measures are indicators of the overall condition of NASA's facility assets. The DM method is designed for application to a large population of facilities; results are not necessarily applicable for individual facilities or small populations of facilities. Under this methodology, NASA defines acceptable operating conditions in accordance with standards comparable to those used in private industry, including the aerospace industry. Using the DM method, NASA's estimate of its backlog of maintenance and repair is approximately \$2.3 billion for both active and inactive facilities.

Deferred maintenance related to heritage assets is included in the deferred maintenance for general facilities. Maintenance is not deferred on active assets that require immediate repair to restore them to safe working condition and have an Office of Safety and Mission Assurance Risk Assessment Classification Code 1 (see NASA STD 8719.7)

National Aeronautics and  
Space Administration

**Office of Inspector General**  
Washington, DC 20546-0001



JAN 28 2004

TO: A/Administrator  
B/Chief Financial Officer

FROM: W/Inspector General

SUBJECT: Audit of the National Aeronautics and Space Administration's  
Fiscal Year 2003 Financial Statements

Under the Chief Financial Officers (CFO) Act of 1990, NASA's financial statements are to be audited in accordance with generally accepted government auditing standards. The Office of Inspector General (OIG) selected the independent certified public accounting firm PricewaterhouseCoopers LLP (PwC) to audit NASA's financial statements in accordance with Government Auditing Standards and Office of Management and Budget (OMB) Bulletin 01-02, "Audit Requirements for Federal Financial Statements." The Defense Contract Audit Agency (DCAA) performed supporting work related to contractor-held, NASA-owned material and property, plant, and equipment.

In the enclosed *Report of Independent Auditors*, dated January 20, 2004, PwC disclaimed an opinion on NASA's financial statements for the fiscal year ended September 30, 2003. The disclaimer resulted from NASA's inability to provide PwC with sufficient evidence to support the financial statements and complete their audit within timeframes OMB established.

PwC's *Report of Independent Auditors on Internal Control* includes five reportable conditions of which four are considered to be material weaknesses. Material weaknesses were found in NASA's: (1) ability to provide documentation and an audit trail to support the financial statements, (2) controls reconciling Fund Balance with Treasury, (3) financial statement preparation, and (4) controls over property, plant, and equipment. Less significant weaknesses were found in security controls over NASA's financial management systems. As a result of the material weaknesses identified in internal controls, PwC's *Report of Independent Auditors on Compliance with Laws and Regulations* states that NASA's financial management system is not in compliance with the requirements of the Federal Financial Management Improvement Act (FFMIA).

To address the weaknesses in NASA's financial management system, we recommend that NASA establish senior management teams to:

- Ensure there is an appropriately staffed organizational structure that can address the Agency's financial management and accountability challenges.
- Review current accounting policies and procedures to ensure they are consistent with applicable standards and are consistently applied.

- Establish internal controls that will provide reasonable assurance that the financial statements are supported, complete and accurate.
- Address problems with the implementation of the Integrated Financial Management Program, including those identified by the General Accounting Office in its November 2003 reports.
- Implement the recommendations made in PwC's *Report of Independent Auditors on Internal Control*.

PwC is responsible for each of the enclosed reports and the conclusions expressed within. Accordingly, we do not express an opinion on NASA's financial statements, conclusions about internal controls over financial reporting, or compliance with certain laws and regulations including, but not limited to, FFMIA.

In fulfilling our responsibilities under the CFO Act, we provided oversight and technical support. We monitored the progress of the audit, coordinated the work performed by the DCAA, reviewed reports submitted by PwC and the DCAA, and ensured that PwC met their contractual requirements.



Robert W. Cobb

3 Enclosures

## Report of Independent Auditors

To Office of Inspector General of the  
National Aeronautics and Space Administration:

We were engaged to audit the accompanying Consolidated Balance Sheet of the National Aeronautics and Space Administration (NASA) as of September 30, 2003, and the related Consolidated Statements of Net Cost, of Changes in Net Position, and of Financing and the Combined Statement of Budgetary Resources for the year then ended. These financial statements are the responsibility of NASA's management.

As discussed in the following paragraph, NASA did not provide sufficient documentary evidence in support of its financial statements as of and for the year ended September 30, 2003, thereby limiting the scope of our work such that we are not able to express, and we do not express, an opinion on these financial statements.

During fiscal year 2003, NASA implemented an Integrated Financial Management Program (IFMP) system, specifically the Core Financial Module. NASA management identified significant errors in its June 30, 2003, financial statements resulting from the implementation of the IFMP system. NASA management communicated that it would correct these errors in the September 30, 2003, financial statements. When NASA first prepared its September 30, 2003, financial statements, NASA concluded that these financial statements also contained significant errors. NASA's efforts to correct these errors led to significant delays in its completion of the September 30, 2003, financial statements and its compilation of documentation in support of amounts and disclosures in these financial statements, including support for resolution of the June 30, 2003, financial statement errors. The documentation NASA provided in support of its September 30, 2003, financial statements was not adequate to support \$565 billion in adjustments to various financial statement accounts, which it identified as being related to the conversion of data to the IFMP system; \$2 billion in net adjustments to its Fund Balance with Treasury account, which had the effect of reducing NASA's recorded balance so it equaled Treasury's reported balance; and its corrections of the financial data errors that affected its June 30, 2003, and September 30, 2003, financial statements. Because of the delays in preparation of the September 30, 2003, financial statements, it was not possible to pursue further evidence in support of these transactions and amounts, nor was it possible to complete other planned auditing procedures within the reporting deadline established by Office of Management and Budget (OMB). Thus, we could not complete our audit and were unable to determine whether there were other matters that are required to be reported.





Report of Independent Auditors  
Page 2 of 3

The following three paragraphs describe departures from accounting principles generally accepted in the United States of America in NASA's fiscal year 2003 financial statements.

NASA did not disclose in the notes to its financial statements that at September 30, 2003, there was a significant difference between its Fund Balance with Treasury balance per its general ledger and Treasury's reported balance, as required by OMB Bulletin No. 01-09, *Form and Content of Agency Financial Statements*.

NASA's method of presentation of its Statement of Financing for the year ended September 30, 2003 was not consistent with the method of presentation of its Statement of Financing for the year ended September 30, 2002.

In fiscal year 2003, NASA allocated depreciation expenses and capitalized costs on a prorated basis utilizing labor hours charged to NASA's programmatic budget line items. In fiscal year 2002, NASA allocated depreciation expenses and capitalized costs to NASA's programs based on the percentage of current year costs per Center. NASA did not provide justification that this change in accounting method is preferable nor did NASA adequately disclose this change in the notes to its financial statements, as required by Statement of Federal Financial Accounting Standards No. 4, *Managerial Cost Accounting Concepts and Standards for the Federal Government*.

The Management's Discussion and Analysis, Required Supplementary Information, and Required Supplementary Stewardship Information are not required parts of the basic financial statements but are supplementary information required by the Federal Accounting Standards Advisory Board and OMB Bulletin No. 01-09. This information has not been subjected to auditing procedures; accordingly, we express no opinion on this information. Further, we were unable to apply to the information certain procedures prescribed by professional standards within the reporting timelines established by OMB, because of the limitations on the scope of our audit of the financial statements, as discussed in the third paragraph of this report.

We have audited the accompanying Consolidated Balance Sheet as of September 30, 2002, and the related Consolidated Statements of Net Cost, of Changes in Net Position, and of Financing and the Combined Statement of Budgetary Resources for the year then ended. These financial statements are the responsibility of NASA's management; our responsibility is to express an opinion on these financial statements based upon our audit. We conducted our audit of these statements in accordance with auditing standards generally accepted in the United States of America; the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States; and OMB Bulletin No. 01-02, *Audit Requirements for Federal Financial Statements*. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial



Report of Independent Auditors

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statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion. In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of NASA at September 30, 2002, and its net cost, changes in net position, budgetary resources, and financing for the year then ended in conformity with accounting principles generally accepted in the United States of America.

In accordance with *Government Auditing Standards*, we have also issued a report dated January 20, 2004, on our consideration of NASA's internal control over financial reporting and a report dated January 20, 2004, on its compliance with laws and regulations. These reports, which disclose material weaknesses and a reportable condition in internal control and non-compliance with the Federal Financial Management Improvement Act, are an integral part of an audit conducted in accordance with *Government Auditing Standards*, and should be read in conjunction with this report on the financial statements when considering the results of our work.

*PricewaterhouseCoopers LLP*

Washington, D.C.

January 20, 2004

## Report of Independent Auditors on Internal Control

To Office of Inspector General of the  
National Aeronautics and Space Administration:

We were engaged to audit the financial statements of the National Aeronautics and Space Administration (NASA) as of and for the year ended September 30, 2003, and have issued our report thereon dated January 20, 2004, in which we disclaimed an opinion on those financial statements.

In planning and performing our work, we considered NASA's internal control over financial reporting by obtaining an understanding of NASA's internal control, determined whether internal controls had been placed in operation, assessed control risk, and performed tests of controls. We limited our internal control testing to those controls necessary to achieve the objectives described in Office of Management and Budget (OMB) Bulletin No. 01-02, *Audit Requirements for Federal Financial Statements*. We did not test all internal controls relevant to operating objectives as broadly defined by the Federal Managers' Financial Integrity Act (FMFIA) of 1982, such as those controls relevant to ensuring efficient operations. The objective of our work was not to provide assurance on internal control. Consequently, we do not provide an opinion on internal control.

Our consideration of the internal control over financial reporting would not necessarily disclose all matters in the internal control over financial reporting that might be reportable conditions. Under standards issued by the American Institute of Certified Public Accountants (AICPA), reportable conditions are matters coming to our attention relating to significant deficiencies in the design or operation of the internal control that, in our judgment, could adversely affect the agency's ability to record, process, summarize, and report financial data consistent with the assertions by management in the financial statements. Material weaknesses are reportable conditions in which the design or operation of one or more of the internal control components does not reduce to a relatively low level the risk that misstatements in amounts that would be material in relation to the financial statements being audited may occur and not be detected within a timely period by employees in the normal course of performing their assigned functions. Because of inherent limitations in internal controls, misstatements, losses, or noncompliance may nevertheless occur and not be detected. However, we noted certain matters discussed in the following paragraphs involving the internal control and its operation that we consider to be material weaknesses and a reportable condition under standards established by the AICPA and OMB Bulletin No. 01-02.



**Material Weaknesses:**

***NASA Lacks a Sufficient Audit Trail to Support that Its Fiscal Year 2003 Financial Statements Are Presented Fairly***

During our testing, we found that NASA did not maintain or have readily available sufficient documentation to support its financial statements. OMB Circular No. A-123, *Management Accountability and Control*, and the General Accounting Office's (GAO), *Standards for Internal Control in the Federal Government*, require agencies to maintain documentation for transactions, management controls, and other significant events that is clear and readily available for examination. In fiscal year 2003, NASA implemented an Integrated Financial Management Program (IFMP) system, specifically the Core Financial Module. We noted that the complexity of NASA's conversion approach and the pervasiveness of the errors identified during the compilation of its June 30, 2003, and September 30, 2003, financial statements and the resolution of those errors impeded NASA's ability to provide a sufficient audit trail to demonstrate the accuracy and completeness of its September 30, 2003, financial statements.

NASA management identified numerous errors in its June 30, 2003, financial statements resulting from the implementation of the IFMP system:

- NASA's Fund Balance with Treasury balance did not reconcile to the general ledger, and the balance was materially overstated due to data conversion errors.
- The IFMP system did not require data fields to be populated to properly distinguish transactions as Intragovernmental or With the Public on the Consolidated Balance Sheet and Consolidated Statement of Net Cost and to allocate costs on the Consolidated Statement of Net Cost. Those data fields were not populated for all transactions, resulting in errors in classifying transactions as Intragovernmental or With the Public and in allocating costs on the Consolidated Statement of Net Cost.
- The Other line item of \$204 million on the Consolidated Statement of Financing under the Components Not Requiring or Generating Resources could not be explained or supported, indicating that NASA had not correctly reconciled its budgetary resources to its net cost of operations.
- There were inconsistencies with financial statement line items. For example, the Obligations Incurred balance on the Combined Statement of Budgetary Resources did not agree to the Obligations Incurred balance on the Consolidated Statement of Financing, a difference of approximately \$200 million.

The pervasiveness of these errors prevented us from performing significant substantive audit procedures on NASA's June 30, 2003, financial statements.



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NASA management communicated that these and other errors identified by NASA management would be corrected in the September 30, 2003, financial statements. When NASA first prepared its September 30, 2003, financial statements, it concluded that there were still significant problems with the accuracy of its financial statements. NASA's efforts to correct these problems led to significant delays in its completion of these financial statements and its compilation of documentation in support of amounts and disclosures in these financial statements, including support for resolution of the June 30, 2003, financial statement errors.

In preparing its September 30, 2003, financial statements, NASA posted 89 adjustments, outside of its IFMP system. NASA provided 87 of the 89 adjustments, totaling approximately \$582 billion. Per review of the description of the adjustments provided, 39 of these adjustments, totaling nearly \$565 billion, were identified as related to data conversion. NASA's conversion approach included loading into its new financial system transactions from the 7 prior fiscal years as if they were current year activity, thereby overstating NASA's converted balances. As support for the correction of these and other data conversion errors, NASA provided each Center's conversion Center Action Plan. In examining these Center Action Plans, we noted that the original differences between the legacy system balances and the IFMP system beginning balances at conversion totaled approximately \$16 billion, net, and that the amount of differences corrected throughout the fiscal year was approximately \$393 million, net. Additionally, we noted that there were differences not requiring adjustment, totaling approximately \$5 billion, net, as well as remaining differences that needed to be corrected, totaling approximately \$11 billion, net. We noted five adjustments, totaling \$1.5 billion that specifically related to the remaining differences that the Center Action Plans had indicated needed to be corrected at September 30, 2003. However, NASA did not provide sufficient documentary evidence to explain how it addressed the full \$11 billion that the Center Action Plans indicated required correction at September 30, 2003, nor did it provide sufficient documentary evidence to support the purpose and validity of the other \$563.5 billion in adjustments it identified as being related to data conversion.

The transaction populations provided for our statistical sample testing of fiscal year 2003 cost, obligation and disbursement transactions contained significant anomalies. For example, NASA identified significant errors that were caused by a limitation in its IFMP system, whereby the IFMP system did not include all of the necessary accounting detail associated with a transaction when processing the total transaction amount. Additionally, the populations provided included corrections to prior year data. As mentioned above, NASA's conversion approach included converting 7 years of prior year data, which was processed as if it were current year activity. NASA could not readily identify these correction transactions in the populations provided. In both of these examples, NASA did not provide a comprehensive listing of the transactions affected by these anomalies, which resulted in significant delays in finalizing our sample design and alternative testing approach, since we could not adequately define the composition of the transaction populations provided. Furthermore, NASA did not provide sufficient documentation to



support the identification, resolution and correction of these anomalies, in accordance with GAO and OMB internal control standards. This material weakness was not reported in NASA's Federal Managers' Financial Integrity Act (FMFIA) report.

We recommend that NASA Management:

- Establish or revise policies and procedures addressing documentation of non-routine transaction processing, and post-closing adjustments that are consistent with GAO's internal control standards. The policies should enable NASA to provide sufficient evidence to support its financial statements. These policies and procedures should address:
  - Non-routine transactions: During fiscal year 2003, NASA found it necessary to process a significant volume of non-routine transactions in its financial statements. For example, it posted entries to correct differences between the opening balances in its new financial system and the closing balances in its legacy systems. It also reversed and re-posted a number of transactions that led to errors in the June 30, 2003, financial statements. Documentation of such non-routine transactions should include an overview of the event necessitating the non-routine transactions, including the cause of the event, and a description of the processes NASA followed to ensure itself that it has (1) identified all transactions that had been posted to the system in error, (2) reversed only those transactions that were in error, (3) posted accurate corrections of the transactions it reversed, and (4) did not post any transactions other than the authorized corrections. That documentation should be sufficient so that an auditor could reperform NASA's steps and determine if they were executed correctly.
  - Post-closing adjustments: A sufficient audit trail for all adjustments posted outside of its IFMP system needs to be maintained. At a minimum, the audit trail should consist of documentation for each adjustment that includes (1) U.S. Standard General Ledger (SGL) accounts, the debit(s) and credit(s), and the dollar amounts, (2) detailed description of the specific purpose of the adjustment, and (3) source documentation that supports the amount of the adjustment. The supporting documentation should be organized such that it is clear and readily available for examination.
- Apply the documentation standards recommended above to all previously identified significant events, including the errors identified during the implementation of its IFMP system, as well as the compilation of its June 30, 2003, and September 30, 2003, financial statements. Additionally, this

documentation standard should be applied to future significant events to ensure that sufficient documentary evidence exists in support of NASA's transactions, management controls and significant events.

- Prepare an analysis of all adjustments posted outside of its IFMP system, by SGL account and financial statement line item. This will enable NASA to demonstrate an understanding of the magnitude of adjustments associated with each SGL account and financial statement line item as well as assist in the analysis of its financial statements to ensure that logical relationships exist between various financial statement amounts, and that the relationships between the different statements and line items within each statement are appropriate.
- Ensure that the adjustments posted outside of its IFMP system to generate its September 30, 2003, financial statements, are subsequently posted into the IFMP system. This will ensure that NASA's IFMP general ledger is complete, its September 30, 2003, financial statements agree to the system of record, and the beginning balances are accurate for fiscal year 2004.

***NASA Lacks Effective Internal Controls Surrounding Its Fund Balance with Treasury Reconciliations***

A fundamental accounting control is the reconciliation of the general ledger, from which financial statements are prepared, to subsidiary systems and/or records. Reconciliations are necessary to ensure that transactions are completely and accurately recorded and that the reported balances are correct. A critical reconciliation for all Federal agencies is the reconciliation of the agencies' Fund Balance with Treasury balance to the U.S. Department of the Treasury's accounting records. In its report titled, *Financial Audit, Issues Regarding Reconciliations of Fund Balances with Treasury Accounts*, GAO noted that the reconciliation process that agencies perform between their Fund Balances and Treasury accounts is an important tool in ensuring that the federal government is able to accurately measure the full cost of its programs. The lack of effective reconciliations increases the risk of fraud, waste, and mismanagement.

According to NASA's policies and procedures, each Center is required to perform monthly reconciliations of its Fund Balance with Treasury activity per the general ledger to Treasury's reported balance. At two of the five Centers we visited during our interim fieldwork, we noted that supporting documentation from the general ledger could not be provided to substantiate the general ledger amounts captured on each Center's reconciliation between its Fund Balance with Treasury balance to Treasury's reported balance.

NASA communicated that Headquarters also prepares monthly reconciliations of each Center's Fund Balance with Treasury activity per the general ledger to Treasury's



reported balance. We identified significant inconsistencies with the supporting documentation provided for NASA's September 30, 2003, Fund Balance with Treasury balance. For example, we reviewed Headquarters' Fund Balance with Treasury reconciliations as of September 30, 2003, and noted an agency-wide difference of approximately \$43 million, net, between NASA's general ledger and the U.S. Department of the Treasury's reported balance. NASA did not provide sufficient documentary evidence to explain these unreconciled differences. In GAO's report titled, *Financial Audit, Issues Regarding Reconciliations of Fund Balances with Treasury Accounts*, GAO noted that in order to effectively reconcile Fund Balance with Treasury accounts, agencies must timely research and resolve any differences between their records and what Treasury has reported. Additionally, NASA provided approximately 20 adjustments, posted outside of its IFMP system, which indicated that the difference between its Fund Balance with Treasury balance and Treasury's balance was significantly greater than had been presented in its year-end reconciliation. As a result, NASA recorded adjustments of \$2 billion, net, to decrease its Fund Balance with Treasury balance to agree to the U.S. Department of the Treasury's reported balance at September 30, 2003. We determined that 5 out of the 20 adjustments, totaling approximately \$1 billion, related to data conversion errors per the Center Action Plans. The remaining adjustments, which were also identified as related to data conversion, totaled approximately \$3 billion. NASA did not provide sufficient documentary evidence to explain the linkage between these adjustments and the unreconciled differences identified on Headquarters' Fund Balance with Treasury reconciliations as of September 30, 2003. This material weakness was not reported in NASA's FMFIA report.

We recommend that NASA Management:

- Ensure that all reconciling items identified on its Fund Balance with Treasury reconciliations are thoroughly researched, contain documented explanations and resolution actions, and are maintained for a sufficient audit trail.
- Retain all reports and documentation utilized in compiling its Fund Balance with Treasury reconciliations, including all support used in researching and resolving reconciling differences.
- Ensure that its Headquarters policies and procedures for performing its consolidated Fund Balance with Treasury reconciliation are documented and reflect the recommendations stated above.

***NASA's Processes for Preparing Its Financial Statements Still Require Improvement***

In our fiscal year 2002 Report on Internal Controls dated January 24, 2003, we recommended that NASA improve its overall financial reporting process to reasonably assure that information presented on the financial statements and footnote disclosures, are



accurate and are consistent with the requirements of OMB Bulletin No. 01-09, *Form and Content of Agency Financial Statements*. As a result of these recommendations, NASA demonstrated some progress in implementing our recommendations, such as, conducting technical training for its staff and devising an internal quality review checklist. However, some significant weaknesses remain.

Originally, NASA was to provide us with its final September 30, 2003, financial statements on October 31, 2003. However, we received these financial statements on December 10, 2003. NASA management communicated that this delay resulted from data quality issues related to their data conversion effort.

Upon review of the statements, we noted inconsistencies that should have been identified and corrected by NASA management through its internal quality control review. For example, NASA did not disclose in its fiscal year 2003 Fund Balance with Treasury footnote that there was a significant difference between its general ledger and Treasury's reported balance, as required by OMB Bulletin No. 01-09. NASA's method of presentation of its Statement of Financing for the year ended September 30, 2003 was not consistent with the method of presentation of its Statement of Financing for the year ended September 30, 2002. Additionally, in fiscal year 2003, NASA allocated depreciation expenses and capitalized costs on a prorated basis utilizing labor hours charged to NASA's programmatic budget line items. In fiscal year 2002, NASA allocated depreciation expenses and capitalized costs to NASA's programs based on the percentage of current year costs per Center. NASA did not provide justification that this change in accounting method is preferable, nor did NASA adequately disclose this change in the notes to its financial statements, as required by Statement of Federal Financial Accounting Standards (SFFAS) No. 4, *Managerial Cost Accounting Concepts and Standards for the Federal Government*.

Furthermore, during our interim testing we identified situations where costs are not recorded properly. NASA designed its new Core Financial Module to include a system edit whereby if costs (and the corresponding liabilities) are greater than the associated obligations, the difference would not be recorded in NASA's general ledger. Instead, these differences were transferred outside of its general ledger and held in a suspense file until additional funds were obligated and the excess costs (and the corresponding liabilities) could be recorded. Similarly, the Core Financial Module did not allow negative costs or downward adjustments to be recorded in the general ledger. SFFAS No. 1, *Accounting for Selected Assets and Liabilities*, SFFAS No. 4, and NASA's Financial Management Manual require costs to be accrued in the period in which they are incurred and any corresponding liability to be recorded as an account payable, regardless of the associated amounts obligated.

Due to the magnitude and pervasiveness of errors NASA identified during the implementation of its IFMP system and during the compilation of its June 30, 2003, and September 30, 2003, financial statements, the delays in preparation of the September 30,

2003, financial statements, and the lack of sufficient audit trail to support that NASA's financial statements are presented fairly, it was not possible to complete further audit procedures on NASA's September 30, 2003, financial statements within the reporting deadline established by OMB. As a result, we were unable to determine if NASA effectively implemented all of the recommendations outlined in our fiscal year 2002 Report on Internal Controls dated January 24, 2003. This material weakness was not reported in NASA's FMFIA report.

We recommend that NASA Management:

- Continue to improve its financial reporting internal quality review procedures to reasonably assure that information presented on the financial statements, footnote disclosures, Management's Discussion and Analysis (MD&A), Required Supplementary Information, and Required Supplementary Stewardship Information (RSSI) are accurate and are consistent with the requirements of OMB Bulletin No. 01-09. To ensure the accuracy and completeness of work performed, supervisory reviews should be guided by preparation of a comprehensive checklist, such as that included in the GAO/PCIE's *Financial Audit Manual*.
- Complete and document analytical procedures to ensure that logical relationships exist between various financial statement amounts, and that the relationships between the different statements and line items within each statement are appropriate. Variances from expected results should be researched and resolved.
- Devise a NASA-wide detailed timeline with specific milestones to ensure ample time and resources are available to complete the following tasks associated with preparing the financial statements and other elements of the performance and accountability report (1) data collection, (2) data validation, (3) data compilation, and (4) detailed quality review.
- Devise a systematic methodology for ensuring that its accounting policies and procedures are in compliance with generally accepted accounting principles. These policies and procedures should be established at NASA Headquarters and disseminated to the Centers on a timely basis. Additionally, NASA should establish appropriate monitoring controls at the Headquarter level to ensure that all Centers are applying its policies and procedures consistently and uniformly.
- Ensure that systems used to prepare the financial statements are complete and have been sufficiently tested prior to interim and year-end reporting dates.
- Devise short-term and long-term resolutions to these IFMP systematic issues and the lack of internal controls surrounding costs in excess of obligations and downward adjustments.

***NASA Still Lacks Adequate Controls to Reasonably Assure that Property, Plant and Equipment and Materials Are Presented Fairly in the Financial Statements***

During fiscal year 2002, we reported Property, Plant and Equipment (PPE) and Materials together as a material weakness due primarily to the lack of internal controls surrounding Contractor-Held PPE and Materials and NASA-Held Assets in Space and NASA-Held work in progress (WIP). In addition, we reported a lack of adequate oversight by NASA Headquarters to identify deficiencies in the design and operation of internal controls for both components.

During fiscal year 2003, NASA management created an overall Corrective Action Plan (Plan) to remedy deficiencies communicated within last year's report. Deadlines were established and accountability assigned within NASA and its contractors to implement all recommendations in fiscal year 2003.

As a result of this Plan, NASA management demonstrated some progress during the year. However, our fiscal year 2003 testing identified that deficiencies still exist, including significant errors discovered through our substantive testing and unresolved prior year recommended corrective actions at certain individual contractor locations. As a result, we were unable to rely on Contractor-Held PPE and Materials reporting and were required to seek audit satisfaction by extensive substantive testing. Additionally, management is unable to detect and correct significant errors before issuing their financial statements. Both interim and year-end financial statements contained significant accounting and reporting errors.

As such, NASA still lacks adequate internal controls to reasonably assure that PPE and Materials are presented fairly in its financial statements. As a result of the testing that was completed in fiscal year 2003, the following is the status of the recommendations from last year:

- The following prior-year recommendations are considered unresolved:
  - We recommended that NASA require contractors to create plans to resolve their respective deficiencies and NASA establish internal controls and policies and procedures to ensure these are created and carried out. During fiscal year 2003, NASA sent correspondence requesting that this be implemented. However, based upon fiscal year 2003 testing, contractors continue to report significant inaccurate and incomplete PPE and materials data. As such, we consider this recommendation still unresolved.
  - We recommended that NASA ensure that all of its contractors have formal policies and procedures to detect and correct errors reported on the NASA Form (NF) 1018. Errors identified in our fiscal year 2003 testing demonstrated that this recommendation is still unresolved. We also

recommended that NASA require its contractors to review PPE and Materials reported by subcontractors on NF 1018 before submitting to NASA. Although NASA's FAR Supplement now requires these formal policies and procedures, additional errors identified in our fiscal year 2003 testing demonstrate that the internal controls need significant improvement. Specifically, we recommend that NASA management verify that each of its contractors has established and is implementing formal policies and procedures to (1) detect and correct errors reported on the NF 1018 as well as (2) review and verify PPE and Materials reported by subcontractors on the NF 1018 before submitting to NASA. NASA should establish internal controls that corroborate that these policies and procedures are in place and are effective in reducing NF 1018 Contractor reporting risk.

- The remaining recommendations have all been partially implemented and should be completed as soon as possible. This will assist management in meeting accelerated reporting deadlines in the future. For example, the following more significant recommendations should be prioritized:
  - We recommend that NASA transition its fiscal year 2003 Corrective Action Plan into an annual "Audit Plan" that establishes annual objectives pertinent to the Agency's specific PPE and Materials internal control and financial statement reporting goals. The annual objectives should be developed from the results of reviews, inspections, and audits conducted by NASA management, NASA Office of Inspector General, external auditors, and contractors and can include goals such as :
    - Following up on previously reported deficiencies and recommendations, including those issued by DCAA.
    - Reviewing/validating/testing high-risk contractors (e.g., those with prior significant findings and internal control deficiencies or those with significant reported balances) on a thorough and consistent basis to reduce overall NF 1018 reporting risk. Such procedures should include at a minimum an assessment of internal controls and policies and procedures, and if necessary, testing the validation of the contractor's reporting of PPE & Materials (e.g., existence, validity, completeness, accuracy and valuation). In addition, NASA management should consider the inclusion of incentives and penalties for compliance and noncompliance of the NASA FAR Supplement.
    - Continual enhancement of NASA Headquarters Policies and Procedures, NF 1018 Quarterly and Annual Reporting and



Instructions and the NASA FAR Supplement to address risks identified and to ensure that all contractor requirements contained therein meet NASA's needs for financial statement reporting purposes.

- Continuously update checklists for reporting and reviewing PPE and Materials.
- Maintaining regular communications with its contractors (e.g., monthly conference calls, quarterly visits, and internal periodic newsletter/communications).

As internal controls improve, NASA should then consider establishing an annual rotation schedule to review/validate contractors at regular intervals as a proactive and preventive measure.

- As originally recommended last year, NASA attempted to create a team to address and resolve the prior year findings and recommendations. The team, however, lacked sustained senior management involvement. Given the significance of PPE and Materials to NASA financial reporting, we recommend that NASA management establish a team led by a senior member of management and charge that team with resolution of these recommendations surrounding this material weakness.
- During fiscal year 2003, NASA management provided training to its Property Administrators and contractors as recommended. Going forward, we recommend that NASA continue to conduct comprehensive staff training and consider expanding it to focus on specific areas of complexity and risk (e.g., transfer document support and preparation).
- During fiscal year 2003, NASA management modified its NF 1018 reporting for its top 55 contractors from an annual to a quarterly basis. We recommend that NASA further modify the NF 1018 reporting process for the remaining contractors to report on a quarterly basis. This will further facilitate reliable, accurate, and complete quarterly reporting.
- As originally recommended last year, NASA continued to work towards enhancing its requirements to document assets transferred to/from NASA Centers and/or other contractors, including the related transfer forms (e.g., DD 1149, DD 250). Going forward, we recommend that NASA continue to ensure compliance with its documentation requirements by monitoring its contractors through management reviews and inspection visits. Additionally, NASA should continue to require complete supporting

documentation for all PPE and Materials transactions, specifically for asset transfers. Complete supporting documentation includes dates, appropriate dollar amounts, authorizing signatures and invoices or purchase orders behind the transfer document that corroborates the dollar amount. Lastly, we recommend that NASA create a reconciliation process to reconcile all of its asset transfers on a quarterly basis and include within that process formal confirmations between the issuing contractor and the receiving contractor. All of these objectives can be included in the “Annual Audit Plan” described above.

- During fiscal year 2002, we recommended that NASA create formal policies and procedures to ensure all appropriate costs are capitalized as part of NASA-Held Assets in Space and NASA-Held WIP accounts. In addition, we recommended the development of formal cost allocation policies for Assets-in-Space, including specificity of what costs are required to be capitalized and what costs should be expensed. Based upon our fiscal year 2003 testing, we recommend that NASA management enhance its Assets-in-Space policy to specifically include what costs should be capitalized/expensed, including a uniform list of cost identifiers (e.g., Unique Project Numbers [UPNs]) that support each of those assets to ensure its policy is consistently applied and that a sufficient audit trail exists documenting management’s assertions surrounding the value of each asset.

**Reportable Condition:**

***Security Controls in NASA’s Financial Management Systems Environment Need Improvement***

Our testing of the IFMP computing environment responsible for processing NASA’s significant financial applications identified improvements needed to strengthen the design and implementation of NASA’s information security program. The suggested improvements can be grouped into the following four categories:

1. IFMP Security Design and Implementation Needs Improvement

The Core Financial Security Plan (MSFC Information Technology (IT) Security Plan) does not conform to OMB Circular No. A-130, *Management of Federal Information Resources*, which, in turn, references the National Institute of Standards and Technology (NIST) publications on computer security. As a result of these gaps in the Core Financial Security Plan, NASA management has not:

- Documented the security configuration standards used to enforce specific security parameters and settings for the IT architecture supporting the IFMP environment.



- Performed an independent “Certification & Accreditation” (C&A) of both the general support systems and the major business application.

In addition, we noted that NASA’s Procedures and Guidelines (NPG) 2810.1 does not clearly articulate the following:

- Policies and procedures requiring that NASA Centers and departments document the security configurations for all general support systems and major applications.
- Specific procedures on how to conduct a C&A, as well as the frequency of these reviews for all general support systems and major applications.

## 2. IFMP Security Controls Need to be Strengthened

The existing IFMP technical administration procedures and application-level security design need to be improved to provide stronger security over the IFMP application environment. Specific areas of weaknesses noted were:

- System parameters have not been configured to provide the highest level of control.
- High-risk, vendor-supplied profiles were assigned to certain user IDs that have the rights to process system and database updates across all functional and technical areas.
- A significant number of users (technical and end-users) had access to perform activities, such as table maintenance, program processing, database copies, spool management, and batch processing via system-level transactions. The use of system-level transactions for these activities allows a user to bypass manual and system controls that are built into the underlying business processes.
- A significant number of end-users have access to sensitive transactions. In addition, we noted segregation of duty conflicts within the finance and purchasing functions. The existing NASA segregation of duty procedures can only identify user conflicts at the role level, which does not provide adequate visibility of users with access to specific transactions or potential segregation of duty conflicts within a single role.
- Procedures have not been fully or consistently implemented to ensure that visibility and control over user access is properly monitored and addressed. For example, procedures have not been fully implemented for monitoring unused IDs, locked IDs, access re-certifications, and segregation of duty conflicts.

### 3. General IT Controls Around IFMP Need To Be Strengthened

We identified a number of security software parameters that were either incorrectly set or were not operating effectively in the distributed client server architecture. A few examples of the control weaknesses noted were:

- Some programmers were provided access to the application production environment with create and change privileges.
- Inappropriate access to the operating system files was found on a few servers.
- Certain user accounts were not required to authenticate to the IFMP database, allowing a user with access to the operating system to login to the database with no further authentication.

### 4. Oversight Function Supporting IFMP's Security Program Needs Improvement

Our review of the IFMP security program revealed that the roles, responsibilities, and oversight function of the new IFMP computing environment needs to be clarified and strengthened to enforce the consistent application of the agency-wide IT Security Program. Specifically, we noted the following:

- Review of NASA Policies and Guidelines document, NPG-2810, and discussions with IFMP management personnel revealed a “center-centric” approach to IT security that NASA has attempted to apply to the new integrated IFMP financial management system. Under the “center-centric” approach, each of NASA’s Centers is responsible for developing and maintaining appropriate security guidelines that are relevant to their operation. However, such a decentralized approach, when applied to the IFMP processing environment, creates a potential for conflicts between the different security policies and procedures implemented by the NASA Chief Information Officer’s (CIO) office, NASA Centers, and IFMP.
- There appeared to be no mechanism in place to ensure that periodic security controls testing and evaluations are performed by a separate entity within NASA, such as NASA’s CIO office. We noted that the lack of periodic reviews and resulting modifications to the security parameters to ensure compliance with various NASA security plans that guide security at IFMP contributed to the security vulnerabilities.
- NASA Center IT Security Administrators do not report to the IFMP Security Manager; they only report to their immediate superiors for Center-specific issues pertaining to the application security.

It should be noted that NASA has taken steps in fiscal year 2003 to address these concerns. Specifically, NASA has tasked the Office of Security Management and Safeguards (OSMS) to address the Information Assurance function on an organization-wide basis. The role of OSMS will be codified in the revised version of NASA's NPG-2810 document. OSMS will be granted the authority to perform internal security reviews on a periodic basis.

However, the control weaknesses, noted above, can adversely impact the control environment and result in a number of negative consequences, including diminished system stability, degraded system performance, and reduced data integrity. Specific risks include the following:

- By not having clearly documented security configuration standards, NASA runs the risk of bringing a new general support system on-line that is not configured in accordance with agreed-upon standards.
- By not conducting an initial certification and accreditation, NASA management runs the risk of operating a financially significant application that does not meet the security requirements of the NPG 2810.1 regarding security plans, as well as those prescribed by OMB Circular No. A-130.
- By not having completely documented policies and procedures, NASA may not be able to maintain operations due to turnover of NASA and contractor personnel.

We recommend that NASA Management:

- Update NPG 2810.1 to require documentation of security configurations for the installation of software for all major applications and general support systems, as well as guidelines for conducting C&As in accordance with OMB and the NIST guidelines. The Core Financial Security Policy should then be updated to reflect the revised NPG 2810.1.
- Document the technical security configurations for all IFMP major applications and general support systems deployed during the implementation effort.
- Ensure that the C&A process is conducted by an independent party for all IFMP major applications and general support systems:
  - Update the existing IFMP technical administration procedures and application-level security design.



- Perform an independent certification of the financial management system to determine the effectiveness of the controls.
- Finalize its plan that will provide the requisite authority within NASA to perform the information assurance function comprising periodic security controls testing and evaluation and other security-related testing. Further, provide IFMP management with the results of such testing and address the vulnerabilities noted in a timely manner.
- Clarify the roles, responsibilities, oversight functions, and protocol to ensure appropriate IT security monitoring and review for the IFMP Program as a whole.

\* \* \*

With respect to NASA's internal control over RSSI and performance measures reported in the fiscal year 2003 Performance and Accountability Report, Management's Discussion and Analysis – Performance Achievement Highlights, we were unable to apply certain procedures prescribed by OMB Bulletin No. 01-02 within the reporting timelines established by OMB, because of the limitations on the scope of the audit of the financial statements, as discussed in our Report of Independent Auditors, dated January 20, 2004. Further, we did not audit and do not express an opinion on such controls.

We also noted certain other matters involving internal controls that we will report to NASA management in a separate management letter.

This report is intended solely for the information and use of management and Office of Inspector General of NASA, OMB, and Congress, and is not intended to be and should not be used by anyone other than these specified parties.

*PriceWaterhouseCoopers LLP*

Washington, D.C.  
January 20, 2004

## Report of Independent Auditors on Compliance with Laws and Regulations

To Office of Inspector General of the  
National Aeronautics and Space Administration:

We were engaged to audit the financial statements of the National Aeronautics and Space Administration (NASA) as of and for the year ended September 30, 2003, and have issued our report thereon dated January 20, 2004, in which we disclaimed an opinion on those financial statements.

The management of NASA is responsible for complying with laws and regulations applicable to the agency. We performed tests of its compliance with certain provisions of laws and regulations, noncompliance with which could have a direct and material effect on the determination of financial statement amounts, and certain other laws and regulations specified in Office of Management and Budget (OMB) Bulletin No. 01-02, *Requirements for Federal Financial Statements*, including the requirements referred to in the Federal Financial Management Improvement Act (FFMIA) of 1996. We limited our tests of compliance to these provisions, and we did not test compliance with all laws and regulations applicable to NASA. Providing an opinion on compliance with certain provisions of laws and regulations was not the objective of our work; accordingly, we do not express such an opinion.

Under FFMIA, we are required to report whether the agency's financial management systems substantially comply with the Federal financial management systems requirements, applicable Federal accounting standards, and the United States Government Standard General Ledger (SGL) at the transaction level. To meet this requirement, we performed tests of compliance with FFMIA section 803(a) requirements. However, as noted in our report dated January 20, 2004, in which we disclaimed an opinion on those financial statements, and based upon the results of the tests we were able to complete, we noted certain instances, described below, which indicated that NASA's financial management systems did not substantially comply with Federal financial management systems requirements, applicable Federal accounting standards, and SGL requirements. Because we could not complete our audit, we were unable to determine whether there were other instances of noncompliance with laws and regulations that are required to be reported.

We reported that NASA has material weaknesses related to (1) its audit trail to support that NASA's September 30, 2003, Financial Statements are presented fairly, (2) internal controls surrounding NASA's Fund Balance with Treasury reconciliations, (3) its processes for preparing its financial statements, and (4) internal controls surrounding Property, Plant and Equipment and Materials. In addition, we noted a reportable condition surrounding the design and implementation of NASA's information security program. Further details on these findings, together with our recommendations for corrective action, have been reported separately to NASA in our report on internal control dated January 20, 2004.





Statement of Federal Financial Accounting Standards (SFFAS) No. 1, *Accounting for Selected Assets and Liabilities*, SFFAS No. 4, *Managerial Cost Accounting Concepts and Standards for the Federal Government*, and NASA's Financial Management Manual, require costs to be accrued in the period in which they are incurred and any corresponding liability to be recorded as an account payable, regardless of the associated amounts obligated. However, NASA has designed its new Core Financial Module to include a system edit whereby if costs (and the corresponding liabilities) are greater than the associated obligations, the difference will not be recorded in NASA's general ledger. Instead, these differences are transferred outside of its general ledger and held in a suspense file until additional funds are obligated and the excess costs (and the corresponding liabilities) can be recorded. Similarly, the Core Financial Module will not allow negative costs or downward adjustments to be recorded in the general ledger. We believe that NASA's accounting treatment of costs in excess of obligations and downward adjustments during fiscal year 2003 represents substantial noncompliance with the Federal accounting standards requirements and SGL requirements under FFMIA. We believe that these matters, including the material weaknesses and reportable condition identified in the preceding paragraph, taken together, represent substantial noncompliance with the Federal financial management systems requirements under FFMIA.

In addition, the General Accounting Office's (GAO) report titled, *Business Modernization: NASA's Integrated Financial Management Program Does Not Fully Address Agency's External Reporting Issues*, dated November 2003, also concluded that NASA's Core Financial Module does not substantially comply with FFMIA and identified additional areas of noncompliance. Specifically, GAO reported that NASA's Core Financial Module does not substantially comply with Federal financial management system requirements, as it does not capture and record upward and downward adjustments of obligations incurred in prior fiscal years, and it posts obligations to the general ledger prior to approval. Additionally, the Core Financial Module does not substantially comply with the SGL at the transaction level, since it does not accumulate transaction-based support for adjustments to prior year obligations. The Core Financial Module does not yet provide full-cost accounting capabilities in accordance with SFFAS No. 4, since NASA has not defined, configured, or tested the appropriate cost pools and cost allocation structure, which are critical to implementing full-cost accounting.

We believe that NASA should assign priority to corrective actions for these FFMIA related matters consistent with the requirements of OMB Circular No. A-50, Revised, on audit follow-up.

This report is intended solely for the information and use of the management and Office of Inspector General of NASA, OMB, and Congress, and is not intended to be and should not be used by anyone other than these specified parties.

Washington, D.C.  
January 20, 2004

National Aeronautics and  
Space Administration  
**Headquarters**  
Washington, DC 20546-0001



January 27, 2004

**TO:** W/Inspector General  
**FROM:** B/Chief Financial Officer  
**SUBJECT:** Management Response to Audit Report of Independent Auditors

We appreciated the efforts of the Office of Inspector General (OIG) working with their contractor, *PriceWaterhouseCoopers*, to audit NASA's fiscal years 2002 and 2003 financial statements. As the Chief Financial Officer (CFO) of NASA it is disturbing to receive a disclaimer of an audit opinion. However, it helps underscore the significant amount of work and challenges facing our NASA financial management team for 2004; challenges which we accept willingly.

Throughout most of fiscal year (FY) 2003, NASA was implementing, in phases, a commercial, off-the-shelf, Agency-wide, integrated financial management system: SAP Core Financials application module, replacing 10 disparate accounting systems in operation at our Centers for the past two decades. This conversion effort created some complex accounting issues for FY 2003, which significantly impacted the timeliness and initial quality of the information required in preparing NASA's interim and year-end financial statements.

NASA had anticipated that its fiscal year 2003, being a conversion year to this new Agency-wide accounting system, was going to be an especially challenging time for its external financial reporting activities. Eight of ten Centers went through this conversion process during the fiscal year, and accordingly, required NASA to use "blended" data from each Center's legacy accounting system and the new SAP Core Financials system to ultimately prepare our consolidated FY 2003 financial statements.

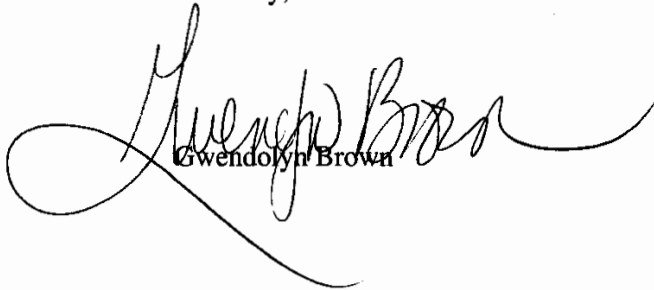
We were aware of this added complexity and initially briefed the OIG and *PriceWaterhouseCoopers* in early March 2003 on our strategy and plans for supporting the forthcoming 2003 audit effort and preparing our consolidated financial statements. To better support this unique integration requirement, NASA replaced its existing manual process for preparing consolidated statements with a hybrid "one-use" database environment that blended the data from various systems and used financial statement templates consistent with guidance issued by the Department of the Treasury and the Office of Management and Budget. Unfortunately, severe initial data quality issues related to the conversion effort impacted negatively our ability to prepare our financial statements in a timely manner, which resulted in the current disclaimer of our audit opinion.



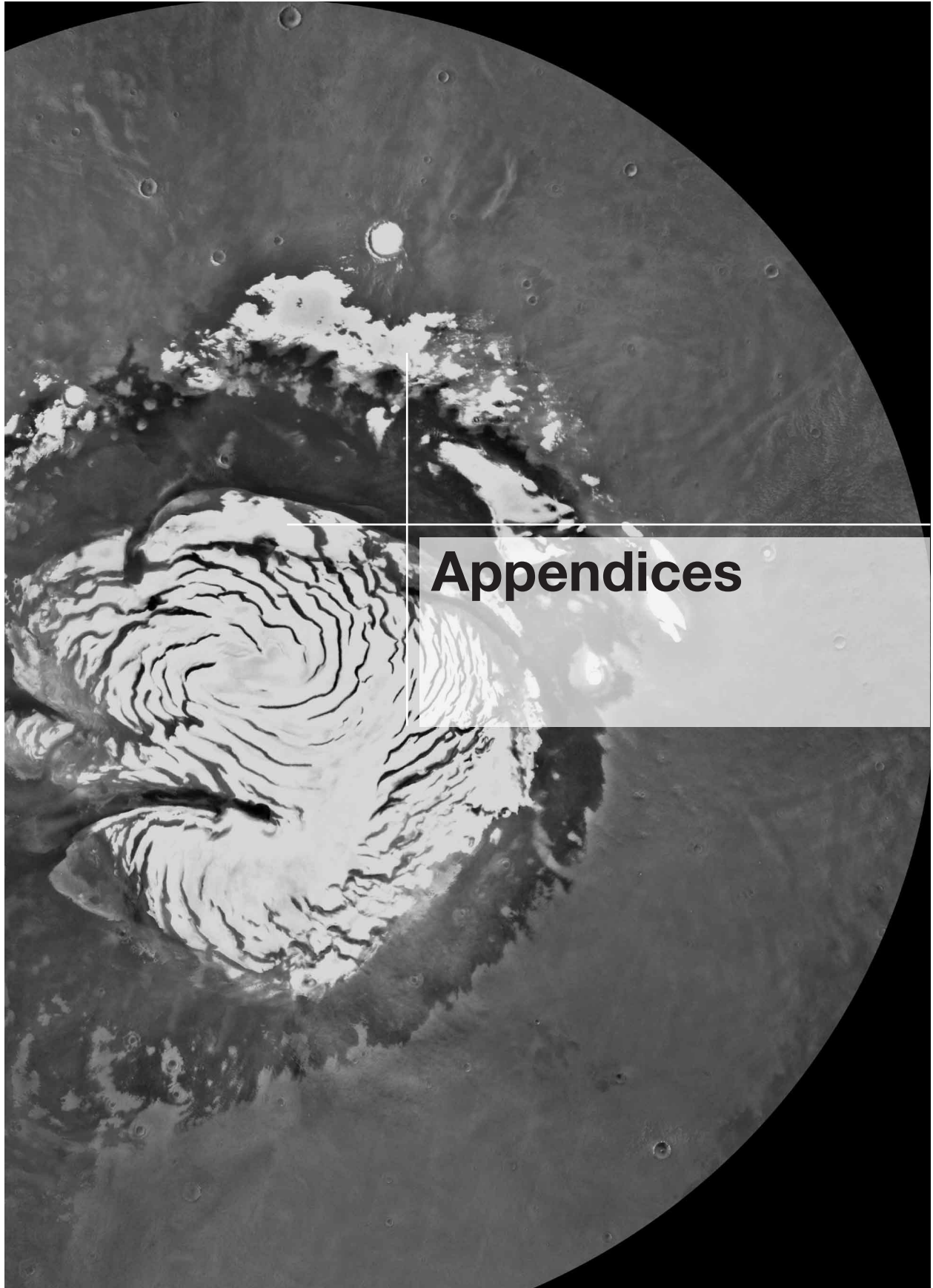
Moving forward, NASA will seriously consider all recommendations made by *PriceWaterhouseCoopers*, and will work with the OIG and its auditors to develop and implement the necessary planned corrective actions responsive to the FY 2003 audit findings.

My staff and I look forward to working with the OIG and its external auditors during the coming year to significantly improve our FY 2004 financial statement audit results.

Sincerely,



Gwendolyn Brown



# Appendices



# Appendix I: NASA's APG Performance Trends for FY 2000 to FY 2003

Following are tables of NASA's annual performance goals (APGs) for fiscal years 2000 to 2003 organized by NASA's 18 Themes and their associated objectives. The tables display performance results/ratings for the past four fiscal years as required by the Office of Management and Budget's Circular A-11 and the Government Performance and Results Act. Performance results/ratings for each APG are indicated by color as follows:

- **Blue:** Significantly exceeded annual performance goal.
- **Green:** Achieved annual performance goal.
- **Yellow:** Did not achieve annual performance goal, progress was significant and achievement is anticipated during the next fiscal year.
- **Red:** Failed to achieve annual performance goal, do not anticipate completion during the next fiscal year.
- White:** Annual performance goal postponed or cancelled by management directive.

## HOW TO USE THE TREND TABLES

Figure I-1 describes the APG numbering scheme. Each APG (e.g., 2S8) starts with a number. This number refers to the Fiscal Year (FY) for which performance is being measured and reported (i.e., "2" represents FY 2002). The letter following the year identifies the responsible Enterprise (i.e., "S" refers to the Space Science Enterprise). The final number is the number of the APG (i.e., 2S8 is the eighth APG under the Enterprise).

The organization of the trend table rows does not necessarily imply consistency or continuity of APGs across all fiscal years. Those APGs that are the same or very similar from one year to the next are marked with an arrow to indicate

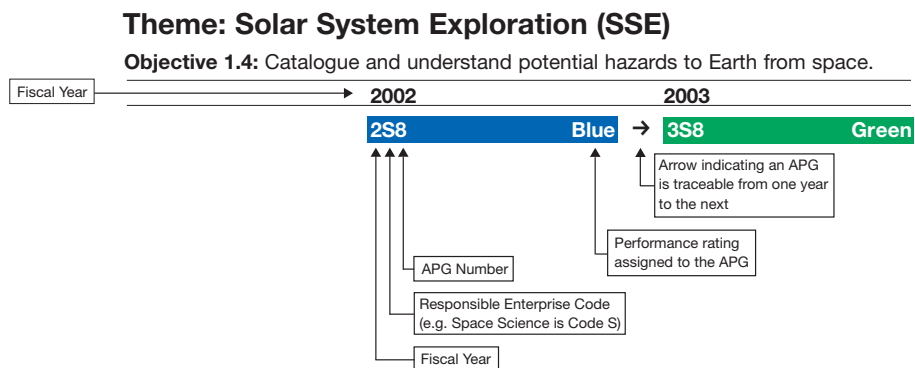


Figure I-1: Guide to NASA's performance trend tables.

continuity from one year to another. Where there are no arrows, APGs have been modified from year to year.

In late FY 2003, NASA adopted changes that will bring greater stability to the Agency's annual performance planning system in FY 2004 and beyond, but the utility and value of performance trend analyses over the past several years has been erratic. In some cases, tracking performance trends by comparing APG color ratings from one fiscal year to another produces useful information. For example, within the Aeronautics Technology Theme (AT), Objective 2.2 is comprised of one APG, and it is clear that over the last four years, performance in this APG has been consistently successful or better. The APGs within all objectives in the Earth System Science (ESS) Theme also depict steady improvement since FY 2000.

However, simply comparing color ratings from one fiscal year to another can imply performance trends that may not be valid. For example, a shift in an APG's color rating from Green in FY 2002 to Yellow in FY 2003 might reflect a number of factors other than deteriorating performance (e.g., resource reallocations or shifts in program priorities). Changes in the number and/or content of APGs from one year to the next also can signal a positive or negative performance trend, but this type of change usually reflects other conditions such as: modifications to the structure of the annual performance plan (e.g., re-mapping the APGs to objectives in NASA's Strategic Plan); completion or updating of existing APGs; and/or development of new APGs. (Specific reasons for changes in FY 2003 are discussed in Part 2 of this report.)

NASA now has in place a good framework of long-term outcomes that will contribute to more stable annual performance plans in the future. NASA also is working diligently to make APGs more meaningful, measurable, and consistent. The result should be more valid performance trend tracking by the Agency and its stakeholders, as well as greater visibility of NASA's achievements to the American people.

## Theme: Solar System Exploration (SSE)

**Objective 1.4:** Catalogue and understand potential hazards to Earth from space.

2000	2001	2002	2003
OS68 Green	1S10 Blue	2S8 Blue	3S8 Green
OS69 Green	1S12 Yellow	2S10 Green	3S10 Green
OS20 Green		2S11 Green	3S11 Green
OS32 Green		2S9 Green	3S9 Yellow
OS42 Green			
OS37 Green			
OS47 Red			
OS49 Green			

**Objective 5.1:** Learn how the solar system originated and evolved to its current diverse state.

2000	2001	2002	2003
OS16 Green	1S5 Green	2S3 Green	3S3 Green
OS31 Green	1S6 Green	2S5 Green	3S5 Green
OS68 Green	1S8 Green	2S10 Green	3S10 Green
OS69 Green	1S10 Blue	2S11 Green	3S11 Green
OS32 Green	1S4 Green	2S9 Green	3S9 Yellow
OS42 Green	1S12 Yellow		
OS45 Blue			
OS34 Green			
OS58 Red			
OS64 Red			
OS70 Red			
OS45 Blue			
OS56 Red			
OS49 Green			
OS50 Yellow			
OS57 Red			

**Objective 5.2:** Understand how life begins and evolves and determine the characteristics of the solar system that led to the origin of life.

2000	2001	2002	2003
OS68 Green	1S5 Green	2S6 Green	3S6 Green
OS69 Green	1S6 Green	2S10 Green	3S10 Green
OS20 Green	1S8 Green	2S11 Green	3S11 Green
OS32 Green	1S12 Yellow	2S9 Green	3S9 Yellow
OS45 Blue			
OS34 Green			
OS37 Green			
OS47 Red			
OS58 Red			
OS64 Red			



**Objective 5.2 (continued):** Understand how life begins and evolves and determine the characteristics of the solar system that led to the origin of life.

2000	2001	2002	2003
OS70 Red			
OS45 Blue			
OS56 Red			
OS49 Green			
OS50 Yellow			
OS57 Red			

**Objective 7.1:** Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

2000	2001	2002	2003
OS67 Green	1S9 Green	2S12 Blue	→ 3S12 Green

### Theme: Mars Exploration Program (MEP)

**Objective 5.3:** Understand the current state and evolution of the atmosphere, surface, and interior of Mars.

2000	2001	2002	2003
OS29 Yellow	1S4 Green	2S10 Green	→ 3S10 Green
OS30 Yellow	1S5 Green	2S11 Green	→ 3S11 Green
OS40 Red	1S14 Blue	2S9 Green	→ 3S9 Yellow
OS46 Green	1S10 Blue	2S5 Green	→ 3S5 Green
OS49 Green	1S12 Yellow		
OS68 Green			
OS69 Green			

**Objective 5.4:** Determine if life exists or has ever existed on Mars.

2000	2001	2002	2003
OS68 Green	1S4 Green	2S6 Green	→ 3S6 Green
OS69 Green	1S5 Green	2S10 Green	→ 3S10 Green
OS29 Yellow	1S14 Blue	2S11 Green	→ 3S11 Green
OS30 Yellow	1S10 Blue	2S9 Green	→ 3S9 Yellow
OS40 Red	1S12 Yellow		
OS41 Red			
OS46 Green			
OS49 Green			

**Objective 5.5:** Develop an understanding of Mars in support of possible future human exploration.

2000	2001	2002	2003
OS68 Green	1S4 Green	2S8 Blue	→ 3S8 Green
OS69 Green	1S5 Green	2S10 Green	→ 3S10 Green
OS29 Yellow	1S14 Blue	2S11 Green	→ 3S11 Green
OS30 Yellow	1S10 Blue	2S9 Green	→ 3S9 Yellow
OS40 Red	1S12 Yellow		
OS41 Red			

**Objective 5.5 (continued):** Develop an understanding of Mars in support of possible future human exploration.

2000	2001	2002	2003
OS46 Green			
OS49 Green			

**Objective 7.1:** Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

2000	2001	2002	2003
OS67 Green	1S9 Green	2S12 Blue	3S12 Green

## Theme: Astronomical Search for Origins (ASO)

**Objective 5.8:** Learn how galaxies, stars, and planetary systems form and evolve.

2000	2001	2002	2003
OS68 Green	1S2 Blue	2S2 Green	3S2 Green
OS69 Green	1S3 Green	2S3 Green	3S3 Green
OS4 Yellow	1S7 Green	2S10 Green	3S10 Green
OS43 Green	1S12 Yellow	2S11 Green	3S11 Green
OS5 Yellow	1S14 Blue	2S9 Green	3S9 Yellow
OS12 Green		2S4 Green	3S4 Blue
OS53 Red			
OS65 Red			
OS66 Red			
OS28 Red			
OS49 Green			
OS62 Yellow			
OS32 Green			
OS55 Yellow			
OS52 Green			
OS54 Red			

**Objective 5.9:** Understand the diversity of worlds beyond our solar system and search for those that might harbor life.

2000	2001	2002	2003
OS69 Green	1S3 Green	2S4 Green	3S4 Blue
OS68 Green	1S2 Blue	2S10 Green	3S10 Green
OS4 Yellow	1S8 Green	2S6 Green	3S6 Green
OS53 Red	1S14 Blue	2S11 Green	3S11 Green
OS49 Green	1S12 Yellow	2S9 Green	3S9 Yellow
OS55 Yellow			
OS52 Green			
OS54 Red			
OS28 Red			

**Objective 7.1:** Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

2000	2001	2002	2003
0S67 Green	1S9 Green	2S12 Blue	3S12 Green

## Theme: Structure and Evolution of the Universe (SEU)

**Objective 5.10:** Discover what powered the Big Bang and the nature of the mysterious dark energy that is pulling the universe apart.

2000	2001	2002	2003
0S1 Green	1S1 Yellow	2S1 Green	3S1 Blue
0S7 Yellow	1S3 Green	2S10 Green	3S10 Green
0S9 Green	1S12 Yellow	2S11 Green	3S11 Green
0S65 Red		2S9 Green	3S9 Yellow
0S66 Red			
0S28 Red			
0S49 Green			
0S68 Green			
0S69 Green			

**Objective 5.11:** Learn what happens to space, time, and matter at the edge of a black hole.

2000	2001	2002	2003
0S2 Green	1S2 Blue	2S2 Green	3S2 Green
0S3 Yellow	1S3 Green	2S10 Green	3S10 Green
0S6 Green	1S12 Yellow	2S11 Green	3S11 Green
0S11 Green	1S1 Yellow	2S9 Green	3S9 Yellow
0S1 Green			
0S14 Red			
0S63 Green			
0S65 Red			
0S28 Red			
0S49 Green			
0S68 Green			
0S69 Green			

**Objective 5.12:** Understand the development of structure and the cycles of matter and energy in the evolving universe.

2000	2001	2002	2003
0S2 Green	1S2 Blue	2S1 Green	3S1 Blue
0S6 Green	1S3 Green	2S2 Green	3S2 Green
0S1 Green	1S1 Yellow	2S10 Green	3S10 Green
0S49 Green	1S12 Yellow	2S11 Green	3S11 Green
0S8 Yellow		2S9 Green	3S9 Yellow
0S9 Green			
0S11 Green			
0S63 Green			
0S28 Red			

**Objective 5.12 (continued):** Understand the development of structure and the cycles of matter and energy in the evolving universe.

2000	2001	2002	2003
OS7 Yellow			
OS68 Green			
OS69 Green			

**Objective 7.1:** Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

2000	2001	2002	2003
OS67 Green	1S9 Green	2S12 Blue	3S12 Green

### Theme: Sun-Earth Connection (SEC)

**Objective 1.3:** Understand the origins and societal impacts of variability in the Sun-Earth connection.

2000	2001	2002	2003
OS69 Green	1S5 Green	2S9 Green Green	3S9 Yellow
OS17 Green	1S6 Green	2S10 Green	3S10 Green
OS65 Red	1S11 Green	2S11 Green	3S11 Green
OS18 Yellow	1S12 Yellow	2S7 Green	3S7 Green
OS68 Green		2S8 Blue	3S8 Green
OS19 Yellow			
OS25 Green			
OS26 Green			
OS27 Green			
OS28 Red			
OS24 Green			
OS33 Green			
OS35 Green			
OS38 Green			
OS60 Yellow			
OS61 Yellow			
OS49 Green			

**Objective 5.6:** Understand the changing flow of energy and matter throughout the Sun, heliosphere, and planetary environments.

2000	2001	2002	2003
OS68 Green	1S5 Green	2S10 Green Green	3S10 Green
OS69 Green	1S6 Green	2S11 Green	3S11 Green
OS17 Green	1S11 Green	2S9 Green	3S9 Yellow
OS15 Green	1S13 Green	2S7 Green	3S7 Green
OS65 Red	1S12 Yellow		
OS66 Red			
OS21 Green			
OS22 Yellow			
OS23 Yellow			

**Objective 5.6 (continued):** Understand the changing flow of energy and matter throughout the Sun, heliosphere, and planetary environments.

2000	2001	2002	2003
OS28	Red		
OS24	Green		
OS33	Green		
OS35	Green		
OS36	Yellow		
OS39	Green		
OS48	Green		
OS60	Yellow		
OS61	Yellow		

**Objective 5.7:** Understand the fundamental physical processes of space plasma systems.

2000	2001	2002	2003
OS68	Green	1S5	Green
OS69	Green	1S6	Green
OS65	Red	1S11	Green
OS18	Yellow	1S13	Green
OS19	Yellow	1S12	Yellow
OS21	Green		
OS25	Green		
OS26	Green		
OS27	Green		
OS28	Red		
OS33	Green		
OS35	Green		
OS49	Green		
		2S10	Green
		2S11	Green
		2S9	Green
		2S3	Green
		3S10	Green
		3S11	Green
		3S9	Yellow
		3S3	Green

**Objective 7.1:** Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

2000	2001	2002	2003
OS67	Green	1S9	Green
		2S12	Blue
		3S12	Green

## Theme: Earth System Science (ESS)

**Objective 1.1:** Understand how Earth is changing, better predict change, and understand the consequences for life on Earth.

2000	2001	2002	2003
0Y4	Yellow	1Y3	Yellow
0Y3	Green	1Y4	Green
0Y9	Green	1Y5	Green
0Y1	Green	1Y6	Green
0Y2	Green	1Y11	Green
0Y7	Green	1Y12	Green
0Y10	Green	1Y7	Green
		2Y3	Green
		2Y8	Green
		2Y1	Yellow
		2Y11	Green
		2Y17	Green
		2Y18	Green
		2Y2	Green
		3Y3	Green
		3Y8	Green
		3Y1	Green
		3Y11	Green
		3Y17	Green
		3Y18	Green
		3Y2	Green

**Objective 1.1 (continued):** Understand how Earth is changing, better predict change, and understand the consequences for life on Earth.

2000	2001	2002	2003
0Y37 Green	1Y8 Green	2Y6 Green	3Y6 Green
0Y11 Green	1Y9 Green	2Y12 Green	3Y12 Green
0Y12 Yellow	1Y10 Green	2Y16 Green	3Y16 Green
0Y36 Green	→ 1Y1 Yellow	→ 2Y29 Green	→ 3Y30 Green
0Y26 Blue	1Y2 Blue	→ 2Y30 Blue	→ 3Y31 Green
0Y35 Blue	1Y13 Blue	2Y25 Green	→ 3Y26 Green
0Y47 Green		2Y19 Green	→ 3Y19 Green
0Y19 Green		2Y20 Green	→ 3Y20 Green
0Y38 Green		2Y9 Green	→ 3Y9 Green
0Y13 Green		2Y5 Green	→ 3Y5 Green
0Y14 Green		2Y10 Green	→ 3Y10 Green
0Y22 Green		2Y4 Yellow	→ 3Y4 Yellow
0Y15 Green		2Y14 Green	→ 3Y14 Green
0Y16 Green		2Y21 Green	→ 3Y21 Green
0Y17 Green		2Y7 Green	→ 3Y7 Green
0Y18 Green		2Y13 Green	→ 3Y13 Green
0Y23 Green		2Y15 Green	→ 3Y15 Green
0Y24 Green		2Y22 Green	→ 3Y22 Green
0Y25 Green		2Y31 Green	→ 3Y32 Green
0Y20 Green		2Y26 Red	→ 3Y27 Green
0Y48 Green		2Y27 Red	→ 3Y28 Yellow
0Y27 Blue			3Y23 Green
0Y28 Blue			
0Y29 Blue			
0Y33 Green			
0Y5 Green			
0Y8 Green			
0Y6 Yellow			

**Objective 7.1:** Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions

2000	2001	2002	2003
	1Y18 Green	2Y24 Green	3Y25 Green

## Theme: Earth Science Applications (ESA)

**Objective 1.2:** Expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology.

2000	2001	2002	2003
0Y41 Yellow	1Y14 Green	→ 2Y23 Green	→ 3Y24 Green
0Y46 Green	1Y15 Green		
0Y44 Yellow	1Y16 Green		
0Y43 Green	1Y17 Green		
0Y34 Green			
0Y45 Green			

**Objective 3.1:** Enhance the Nation's security through partnerships with DoD, DHS, and other U.S. or international government agencies.

2000	2001	2002	2003
0Y39 Green		2Y28 Green	→ 3Y29 Green
0Y40 Green			

## Theme: Biological Sciences Research (BSR)

**Objective 4.1:** Determine how fundamental biological processes of life respond to gravity and space environments.

2000	2001	2002	2003
0H1 Green	→ 1H3 Green	2B9 Green	→ 3B7 Green
0H20 Yellow	1H13 Green	2B10 Green	→ 3B8 Green
		2H13 Green	→ 3H13 Yellow

**Objective 4.2:** Expand understanding of fundamental physical processes and insight into the laws of nature through space-based investigation.

2000	2001	2002	2003
			3B3 Green

**Objective 7.1:** Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

2000	2001	2002	2003
		2B14 Green	→ 3B12 Green

**Objective 9.1:** Understand human physiological reactions to reduced gravity and develop countermeasures to assure survival of humans traveling far from Earth.

2000	2001	2002	2003
0H26 Green	1H17 Green	2B1 Green	→ 3B1 Green
0H9 Green	1H5 Green		
0H25 Green			



**Objective 9.2:** Develop new human support systems and solutions to low gravity technological challenges to allow the next generation of explorers to go beyond low Earth orbit.

2000	2001	2002	2003
0H31 Green	1H18 Green	2B2 Green 2B3 Green	→ 3B2 Green

### Theme: Physical Sciences Research (PSR)

**Objective 3.3:** Resolve scientific issues in the low gravity environment of space that enrich life on Earth by leading to better design tools in energy, materials, medical, and communication technologies.

2000	2001	2002	2003
0H1 Green	→ 1H3 Green	2B10 Green	→ 3B8 Green
0H56 Green	1H4 Yellow	2B5 Blue	→ 3B4 Yellow
0H20 Yellow	1H13 Green	2B8 Green 2H13 Green	→ 3B6 Yellow → 3H13 Yellow

**Objective 4.2:** Expand understanding of fundamental physical processes and insight into the laws of nature through space-based investigation.

2000	2001	2002	2003
0H11 Red	1H5 Green	2B4 Green 2B6 Green 2B7 Green	→ 3B3 Green → 3B8 Green → 3B5 Green

**Objective 7.1:** Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

2000	2001	2002	2003
		2B14 Green	→ 3B12 Green

**Objective 9.2:** Develop new human support systems and solutions to low gravity technological challenges to allow the next generation of explorers to go beyond low Earth orbit.

2000	2001	2002	2003
0H33 Green	1H1 N/A 1H31 Green	2B3 Green	

### Theme: Research Partnerships and Flight Support (RPFS)

**Objective 3.2:** Improve the Nation's economic strength and quality of life by facilitating innovative use of NASA technology.

2000	2001	2002	2003
0H1 Green	→ 1H3 Green	2B10 Green	→ 3B8 Green
0H47 Green	1H23 Green	2B11 Green	→ 3B9 Green
0H49 Green	1H22 Blue	2B12 Green	→ 3B10 Blue
0H46 Green		2H13 Green	

**Objective 7.1:** Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

2000	2001	2002	2003
		2B14 Green	→ 3B12 Green

## Theme: Aeronautics Technology (AT)

**Objective 2.1:** Decrease the aircraft fatal accident rate, reduce the vulnerability of the air transportation system to hostile threats, and mitigate the consequences of accidents and hostile acts.

2000	2001	2002	2003
0R3 Yellow	1R1 Yellow	2R1 Green	3R1 Yellow

**Objective 2.2:** Protect local and global environmental quality by reducing aircraft noise and emissions.

2000	2001	2002	2003
0R1 Blue	→ 1R2 Green	→ 2R2 Green	→ 3R2 Green
0R2 Green	→ 1R3 Yellow	→ 2R3 Green	→ 3R3 Green

**Objective 2.3:** Enable more people and goods to travel faster and farther, with fewer delays.

2000	2001	2002	2003
0R4 Green	1R4 Green	2R4 Green	3R4 Green
0R7 Yellow	1R7 Yellow	2R5 Green	3R5 Green

**Objective 3.2:** Improve the Nation's economic strength and quality of life by facilitating innovative use of NASA technology.

2000	2001	2002	2003
	1R9 Red		

**Objective 10.3:** Leverage partnerships between NASA Enterprises, U.S. industrial firms, and the venture capital community for innovative technology development.

APGs under Objective 10.3 will appear in FY 2004.

**Objective 10.4:** Create novel aerospace concepts and technology to support future sustainable human and robotic exploration and development of space.

APGs under Objective 10.4 will appear in FY 2004.

**Objective 10.5:** Create novel aeronautics concepts and technology to support science missions and terrestrial and space applications.

2000	2001	2002	2003
0R11 Green	1R9 Red		
0R10 Green			

## Theme: Education (ED)

**Objective 6.1:** Increase the number of elementary and secondary students and teachers who are involved in NASA-related education opportunities.

2000	2001	2002	2003
0C1 Blue	1CK4 Green	→ 2CK4 Yellow	
0R16 Blue	→ 1R13 Green	→ 2R12 Green	3R16 Green
OS67 Green	1S9 Green	2S12 Blue	→ 3S12 Green
	1Y18 Green	2Y24 Green	→ 3Y25 Green
		2H28 Green	→ 3H23 Green

**Objective 6.2:** Support higher education research capability and opportunities that attract and prepare increasing numbers of students and faculty for NASA-related careers.

2000	2001	2002	2003
0Y30 Green	1H26 Green		3H24 Green
0C14 Red			

**Objective 6.3:** Increase the number and diversity of students, teachers, faculty and researchers from underrepresented and underserved communities in NASA related STEM fields.

2000	2001	2002	2003
0Y31 Blue		2B13 Blue	→ 3B11 Blue
0Y32 Yellow			

**Objective 6.4:** Increase student, teacher, and public access to NASA education resources via the establishment of e-Education as a principal learning support system.  
APGs under Objective 6.4 will appear in FY 2004.

## Theme: International Space Station (ISS)

**Objective 7.1:** Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

2000	2001	2002	2003
		2H24 Yellow	→ 3H22 Green
			3H21 Green

**Objective 8.4:** Assure capabilities for world-class research on a laboratory in low Earth orbit.

2000	2001	2002	2003
0H16 Yellow	1H11 Yellow	2H10 Green	→ 3H11 Green
0H18 Yellow	1H10 Green	2H11 Green	→ 3H12 Green
0H17 Yellow	1H14 N/A	2H19 Yellow	→ 3H15 Green
0H19 Yellow	1H15 N/A	2H17 Green	3H2 Yellow

## Theme: Space Shuttle Program (SSP)

**Objective 7.1:** Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

2000	2001	2002	2003
		2H24 Yellow	3H22 Green 3H21 Green

**Objective 8.3:** Improve the accessibility of space to better meet research, Space Station assembly, and operations requirements.

2000	2001	2002	2003
0H12 Green	→ 1H7 Green	→ 2H6 Green	→ 3H5 Red
0H13 Green	→ 1H30 Green	→ 2H7 Green	→ 3H6 Red
0H15 Red	1H6 Yellow	→ 2H09 Green	→ 3H8 Green
0H14 Green		2H8 Green	→ 3H7 Green
0H39 Red		2H21 Green	3H20 White
0H40 Green			3H25 Yellow
0H41 N/A			

## Theme: Space and Flight Support (SFS)

**Objective 7.1:** Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

2000	2001	2002	2003
		2H24 Yellow	3H22 Green 3H21 Green

**Objective 8.5:** Provide services for space communications, rocket propulsion testing, and launch in support of NASA, other government agencies and industry.

2000	2001	2002	2003
0H42 Green	1H20 Green	2H15 Green	→ 3H16 Yellow
0H43 Green	1H21 Green	2H3 Green	→ 3H3 Blue
0H44 Green	1H1 N/A	2H16 Blue	3H14 Blue
0H35 Red		2H18 Green	→ 3H17 Green
		2H26 Green	→ 3H19 Green
			3H4 Blue
			3H18 Green
			3H10 Green

**Objective 8.6:** Create concepts, technologies and capabilities for space transportation that enable affordable future infrastructures.

2000	2001	2002	2003
			3H9 Green

**Objective 9.4:** Develop innovative concepts for systems, infrastructures and missions to extend the duration and boundaries of human space flight.

2000	2001	2002	2003
0H38 Yellow	1P6 Green		3H1 Yellow

### Theme: Space Launch Initiative (SLI)

**Objective 8.1:** Assure safe, affordable, and reliable U.S.-based crew access and return from the International Space Station.

2000	2001	2002	2003
			3SL11 Green
			3SL12 Green
			3SL13 Green

**Objective 8.2:** Improve the safety, affordability and reliability of future space transportation systems.

2000	2001	2002	2003
0R19 Red	1R10 Red	2R6 Green	3R6 See SLI
0R12 Red	1R11 Yellow	2R7 Green	3R7 See SLI
0R17 Red		2R13 Green	3R8 See SLI
0R6 Yellow			3R9 See SLI
			3SL14 Green
			3SL15 Green
			3SL16 Green

### Theme: Mission and Science Measurement Technology (MSM)

**Objective 10.1:** Improve the capability to assess and manage risk in the synthesis of complex engineering systems.

2000	2001	2002	2003
	1R8 Green		3R11 Green

**Objective 10.2:** Create system concepts and demonstrate technologies that will enable new science measurements and scientific missions.

2000	2001	2002	2003
0R8 Green		2R10 Green	3R13 Green
		2R8 Green	3R10 White
			3R12 Green
			3R14 Green

### Theme: Innovative Technology Transfer Partnerships (ITTP)

**Objective 3.2:** Improve the Nation's economic strength and quality of life by facilitating innovative use of NASA technology.

2000	2001	2002	2003
0R15 Blue			
0C22 Blue			
0C15 Red			

Common Aerospace Technology Enterprise APGs that apply to AT, SLI, MSM, and ITTP.

2000	2001	2002	2003
0R13 Red	1R12 Green	2R11 Blue	3R15 Green
0R14 Green			

## Crosscutting Processes

Note: The 2003 APGs in the following tables can be found under Goal 3 (3CK3), Goal 6 (3CK4), Goal 7 (3CK1, 3CK2), and Implementing Strategies in the Detailed Performance Data section.

### Communicate Knowledge

2000	2001	2002	2003
0C3 Green	1CK1 Green	2CK1 Blue	3CK1 Green
0C17 Green	1CK2 Green	2CK2 Blue	3CK2 Blue
0C21 Green	1CK3 Green	2CK3 Blue	3CK3 Green
0C1 Green	1CK4 Green	2CK4 Yellow	3CK4 Green

### Manage Strategically

2000	2001	2002	2003
0MS2 Green	1MS3 Yellow	2MS8 Red	3MS8 Red
0MS3 Blue	1MS1 Yellow	2MS1 Green	3MS1 Yellow
0MS5 Blue	1MS2 Blue	2MS2 Blue	3MS2 Green
0MS8 Blue	1MS2 Blue	2MS9 Yellow	3MS9 Blue
0MS11 Red	1MS3 Green	2MS3 Yellow	3MS3 Yellow
0MS10 Green	1MS4 Green	2MS4 Green	3MS4 Green
	1MS4 Green	2MS5 Green	3MS5 Green
		2MS6 Green	3MS6 Green
		2MS7 Green	3MS7 Green
		2MS10 Green	3MS10 Green

### Provide Aerospace Products and Capabilities

2000	2001	2002	2003
0P1 Red	1P1 Red	2P1 Yellow	3P1 Red
0P2 Blue	1P3 Blue	2P2 Blue	3P2 Yellow
0P6 Blue	1P5 Blue	2P6 Blue	3P3 Blue

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## Appendix II: Inspector General Act Amendment Reports

### **The Inspector General Act Amendments**

The *Inspector General Act* (as amended) requires semiannual reporting on Inspector General (IG) audits and related activities, as well as Agency follow up. Agency follow up reporting is included in this *FY 2003 Performance and Accountability Report*, and as required by Section 106 of the IG Act Amendments (P.L. 100-504), it includes statistics on audit reports with disallowed costs and recommendations that funds be put to better use for FY 2003. It also provides information on the status of audit and inspection reports pending final action as of September 30, 2003.

### **Audit Follow Up**

Over the last year, the Management Assessment Division of the Office of Management Systems has taken positive steps with the Office of Inspector General (OIG) to increase meaningful communications throughout the audit cycle, improve the audit/inspection report process, and reconcile audit-tracking data with the OIG. The division also streamlined management's audit resolution process to enable more efficient management decisions on unresolved recommendations. Additionally, the division transitioned the Agency's corrective action tracking system to a Web-based architecture. The new system provides e-mail notification alerts to assist in audit follow up, as well as enhanced reporting and analysis capabilities.



# Audit and Inspection Reports Pending Final Action

(as of September 30, 2003.)

## AUDIT REPORTS

<b>IG-99-047</b>	<b>09/22/99</b>	<b>IG-01-038</b>	<b>09/27/01</b>
Safety Considerations at Goddard Space Flight Center		NASA's Planning and Implementation for PDD 63	
<b>IG-00-017</b>	<b>03/21/00</b>	<b>IG-02-001</b>	<b>10/25/2001</b>
General Controls at Johnson Space Center's Mission Control Center		Evaluation of NASA Incident Response Capability	
<b>IG-00-034</b>	<b>05/12/00</b>	<b>IG-02-004</b>	<b>11/19/2001</b>
Foreign National Visitors at NASA Centers		Approvals for Accessing Information Technology Systems at MSFC & GRC	
<b>IG-00-055</b>	<b>09/28/00</b>	<b>IG-02-010</b>	<b>03/26/2002</b>
System Information Technology Security Planning		Telephone Management	
<b>IG-00-057</b>	<b>09/28/00</b>	<b>IG-02-011</b>	<b>03/22/2002</b>
NASA's Planning and Implementation for Presidential Decision Directive 63-Phase I		International Space Station Spare Parts Costs	
<b>IG-00-059</b>	<b>09/28/00</b>	<b>IG-02-017</b>	<b>06/04/2002</b>
Software Assurance		Management of Research Grants and Cooperative Agreements	
<b>IG-01-003</b>	<b>12/21/00</b>	<b>G-98-011</b>	<b>08/27/99</b>
Space Shuttle Payloads		Flight Termination Systems	
<b>IG-01-021</b>	<b>03/30/01</b>	<b>G-00-017</b>	<b>10/22/2001</b>
X-37 Technology Demonstrator Project Management		Internet Based Spacecraft Commanding Security Issues	
<b>IG-01-022</b>	<b>03/30/01</b>	<b>G-00-021</b>	<b>02/20/01</b>
Information Technology Security		Assessment of NASA's Use of the Metric System	
<b>IG-01-032</b>	<b>08/22/01</b>	<b>G-01-008</b>	<b>03/27/2002</b>
UNIX Operating System Security and Integrity in MCC at JSC		NASA Penetration Testing	
<b>IG-01-033</b>	<b>08/21/01</b>	<b>G-01-011</b>	<b>08/13/2002</b>
UNIX Operating System Security and Integrity of the New Business Systems at the JPL		Information Technology Security Vulnerabilities at NASA GSFC	
<b>IG-01-036</b>	<b>09/27/01</b>	<b>G-02-004</b>	<b>04/24/2002</b>
NASA's Information Systems Processing National Security Information		HQ Emergency Preparedness Program	

### Statistical Table on Audit Reports with Disallowed Costs

(October 1, 2002 through September 30, 2003.)

		Number of Audit Reports	Dollar Value
<b>A</b>	Audit reports with management decisions on which final action had not been taken at the beginning of the reporting period	0	\$0
<b>B</b>	Audit reports on which management decisions were made during the reporting period	2	<b>\$9,015</b>
<b>C</b>	Total audit reports pending final action during the reporting period (total of A + B)	2	\$9,015
<b>D</b>	Audit reports on which final action was taken during the reporting period		
	<b>1</b> Value of disallowed costs collected by management	2	\$9,015
	<b>2</b> Value of costs disallowed by management	0	\$0
	<b>3</b> Total (lines D1 + D2)	2	\$9,015
<b>E</b>	Audit reports needing final action at the end of the reporting period (C – D3)	0	\$0

# Statistical Table on Audit Reports with Recommendations that Funds Be Put to Better Use

(October 1, 2002 through September 30, 2003.)

		Number of Audit Reports	Dollar Value
<b>A</b>	Audit reports with management decisions on which final action had not been taken at the beginning of the reporting period	0	\$0
<b>B</b>	Audit reports on which management decisions were made during the reporting period	2	\$115,000,000
<b>C</b>	Total audit reports pending final action during the reporting period (Total of A + B)	2	<b>\$115,000,000</b>
<b>D</b>	Audit reports on which final action was taken during the reporting period		
	<b>1</b> Value of recommendations implemented	2	\$115,000,000
	<b>2</b> Value of recommendations that management concluded should not or could not be implemented	0	\$0
	<b>3</b> Total (lines D1 + D2)	2	<b>\$115,000,000</b>
<b>E</b>	Audit reports needing final action at the end of the reporting period (C – D3)	0	\$0

# Appendix III: NASA's Performance and Budget Planning Process

The Agency's planning process includes the development of a strategic plan, annual budget estimates, and a performance plan. The strategic plan is a five-year plan, updated every three years, that defines the Agency's Vision, Mission, Goals, and objectives. The performance plan defines the multi-year outcomes and annual performance goals assigned to each Enterprise. The performance plan and budget estimates are

integrated in the annual budget estimates as the *Integrated Budget and Performance Document (IBPD)*. NASA communicates its performance and progress in meeting the fiscal year performance plan via the performance and accountability report, which also presents the financial status of the Agency. (See Figure III-1 for NASA's planning process and related documents.)

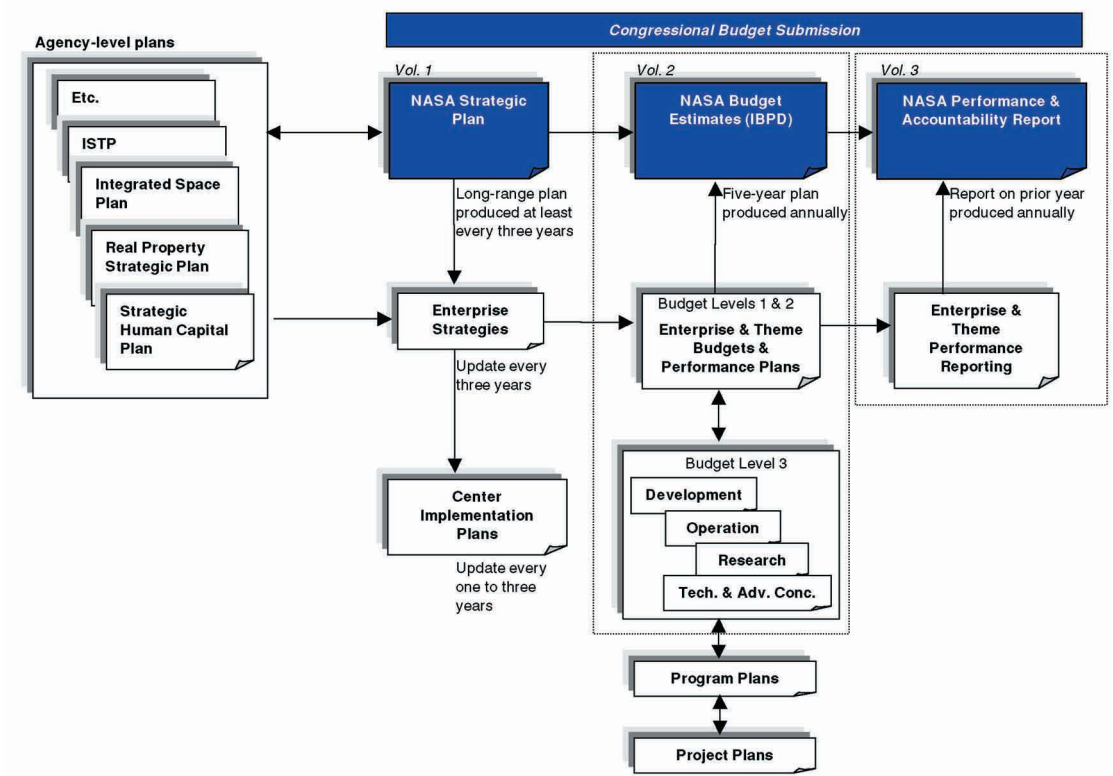


Figure III-1: NASA's budget and performance planning documents.

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# Acronyms

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## A

<b>AFSPC</b>	Air Force Space Command
<b>AGAGE</b>	Advanced Global Atmospheric Gases Experiment
<b>APG</b>	Annual Performance Goal
<b>ASO</b>	Astronomical Search for Origins (Theme)
<b>AT</b>	Aeronautics Technology (Theme)

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## B

<b>BRPE</b>	Biological and Physical Research Enterprise
<b>BSR</b>	Biological Sciences Research (Theme)

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## C

<b>CAIB</b>	<i>Columbia</i> Accident Investigation Board
<b>CAL TECH</b>	California Institute of Technology
<b>CDR</b>	Critical Design Review
<b>CF</b>	Core Financial
<b>CMS</b>	Competency Management System

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## D

<b>DART</b>	Demonstration of Autonomous Rendezvous Technology
<b>DFRC</b>	Dryden Flight Research Center
<b>DoD</b>	Department of Defense

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## E

<b>ED</b>	Education Programs (Theme)
<b>EOS</b>	Earth Observing System
<b>ESA</b>	Earth Science Applications (Theme)
<b>ESMF</b>	Earth System Modeling Framework
<b>ESS</b>	Earth System Science (Theme)
<b>ET</b>	External Tank

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## F

<b>FEMA</b>	Federal Emergency Management Agency
<b>FMFIA</b>	Federal Managers' Financial Integrity Act
<b>FY</b>	Fiscal Year

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## G

<b>GAO</b>	General Accounting Office
<b>GRACE</b>	Gravity Recovery and Climate Experiment
<b>GRC</b>	Glenn Research Center
<b>GSFC</b>	Goddard Space Flight Center

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## H

<b>HST</b>	Hubble Space Telescope
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<b>I</b>	
<b>ICC</b>	Internal Control Council
<b>ICESat</b>	Ice, Cloud, and Land Elevation Satellite
<b>IFM</b>	Integrated Financial Management
<b>IG</b>	Inspector General
<b>ISS</b>	International Space Station (On orbit platform and Theme)
<b>ISTP</b>	Integrated Space Transportation Plan
<b>IT</b>	Information Technology
<b>ITS</b>	Information Technology Security
<b>ITTP</b>	Innovative Technology Transfer Partnerships (Theme)

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<b>J</b>	
<b>JPL</b>	Jet Propulsion Laboratory
<b>JSC</b>	Johnson Space Center

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<b>K</b>	
<b>KSC</b>	Kennedy Space Center

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<b>L</b>	
<b>LaRC</b>	Langley Research Center

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<b>M</b>	
<b>MEP</b>	Mars Exploration Program (Theme)
<b>MER-A</b>	Mars Exploration Rover- A
<b>MER-B</b>	Mars Exploration Rover- B
<b>miniACFS</b>	Advanced Concepts Flight Simulator
<b>MR</b>	Magnetorheological
<b>MSFC</b>	Marshall Space Flight Center
<b>MSM</b>	Mission and Science Measurement Technology (Theme)

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<b>N</b>	
<b>NASA</b>	National Aeronautics and Space Administration
<b>NCEP</b>	National Center for Environmental Prediction
<b>NESC</b>	NASA Engineering and Safety Center
<b>NODIS</b>	NASA Online Directives Information System
<b>NPP</b>	Net Primary Productivity
<b>NSBRI</b>	National Space Biomedical Research Institute

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<b>O</b>	
<b>OIG</b>	Office of Inspector General
<b>OSMA</b>	Office of Safety and Mission Assurance
<b>OSP</b>	Orbital Space Plane

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<b>P</b>	
<b>PAR</b>	Performance and Accountability Report
<b>PI</b>	Principal Investigator
<b>PMA</b>	President's Management Agenda
<b>PP&amp;E</b>	Property, Plant, and Equipment
<b>PSR</b>	Physical Sciences Research (Theme)

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<b>R</b>	
<b>RCC</b>	Reinforced Carbon-Carbon
<b>RLV</b>	Reusable Launch Vehicle
<b>RPFS</b>	Research Partnerships and Flight Support (Theme)
<b>RTF</b>	Return to Flight

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<b>S</b>	
<b>SBIR</b>	Small Business Innovation Research
<b>SCISAT</b>	Scientific Satellite Atmospheric Chemistry Experiment
<b>S'COOL</b>	Students' Cloud Observations On-Line
<b>SEC</b>	Sun-Earth Connection (Theme)
<b>SEU</b>	Structure and Evolution of the Universe (Theme)
<b>SFS</b>	Space and Flight Support (Theme)
<b>SIS</b>	Smart Icing System
<b>SLI</b>	Space Launch Initiative (Theme)
<b>SSC</b>	Stennis Space Center
<b>SSE</b>	Solar System Exploration (Theme)
<b>SSP</b>	Space Shuttle Program (Theme)

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<b>T</b>	
<b>TDRS-J</b>	Tracking and Data Relay Satellite-J
<b>TPS</b>	Thermal Protection System
<b>TRMM</b>	Tropical Rainfall Measuring Mission

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<b>U</b>	
<b>U.S.</b>	United States

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<b>W</b>	
<b>WFF</b>	Wallops Flight Facility

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# NASA Contact Information

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(202) 358-0000  
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**NASA John C. Stennis Space Center (SSC)**

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