

## NASA FY 2017 Budget Request for Science

<u>Actuals</u> <u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017<sup>1</sup></u>	<i>Notional</i> <u>FY 2018</u>	<i>Notional</i> <u>FY 2019</u>	<i>Notional</i> <u>FY 2020</u>	<i>Notional</i> <u>FY 2021</u>
<b>\$5,243M</b>	<b>\$5,589M</b>	<b>\$5,601M</b>	<b>\$5,409M</b>	<b>\$5,517M</b>	<b>\$5,627M</b>	<b>\$5,740M</b>

The FY 2017 budget provides \$5,601 million to the Science Mission Directorate. The budget request:

- Includes five major science areas
  - \$2,032 million for Earth Science to improve climate modeling, weather prediction, and natural hazard mitigation, through Earth observation from space. The budget supports launch of Landsat 9 as early as 2021, and Landsat 10 in approximately 2029. The request also includes funding to increase the capabilities and uses of multi-spacecraft constellations of small scientific satellites.
  - \$1,519 million for Planetary Science to explore the planetary bodies of our solar system. Included is funding for a mission to Jupiter’s moon Europa, for continued operations of the Mars Opportunity, Mars Odyssey, and Mars Express missions, and for the next New Frontiers mission.
  - \$782 million for Astrophysics to study the universe and search for Earth-like planets. The request funds formulation of the Wide Field Infrared Survey Telescope for launch as early as 2025.
  - \$569 million to keep the James Webb Space Telescope on track for launch in 2018.
  - \$699 million for Heliophysics to study the Sun and its influence throughout the solar system. The request accelerates support of the Administration’s Space Weather Action Plan and Space Weather Strategy.
- Supports over ninety space missions
  - About 35 missions currently preparing for launch and 60 operating missions.
  - In addition, ongoing flights of sounding rockets, aircraft, and high-altitude balloons.
- Furthers our search to answer some of humanity’s most profound questions
  - How are Earth’s climate and the environment changing?
  - How and why does the Sun vary and affect Earth and the rest of the solar system?
  - How do planets and life originate?
  - How does the universe work, and what are its origin and destiny?
  - Are we alone?
- Invests in developing advanced technologies
  - Developing optics and detectors to find planets around other stars, rovers to investigate for signs of past or present life on Mars, and new instruments to take the pulse of our planet.
  - Engaging industry, academia, and other government labs via open, competitive solicitations
- Supports over 10,000 U.S. scientists
  - Over 3,000 openly competed research awards with universities, industry, and government labs.
  - World-leading research, frequently highlighted on the covers of *Science*, *Nature*, and major newspapers.
- Includes partnerships with a dozen other Federal agencies and sixty other nations
  - Collaborating with other science agencies and agencies that need science results, including NSF, DOE, NOAA, FAA, USDA, DOI, EPA, and DOD
  - Partnering with longstanding and newly space-faring nations to meet both scientific and foreign policy goals.
  - Building and launching the nation’s weather satellites for NOAA.
- Provides benefits to our nation and our planet
  - Leading the scientific exploration of the Earth, the solar system, and the universe beyond.
  - Enhancing economic growth via high-tech jobs and new technologies and improving quality of life through applications such as improved medical imaging devices.
  - Assisting responses to national and international disasters

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<sup>1</sup> FY 2017 reflects discretionary and mandatory funding. Additional details on the mandatory funding can be found in the Congressional Justification.

## NASA FY 2017 Budget Request for Aeronautics

<b>Actuals</b>			<i>Notional</i>	<i>Notional</i>	<i>Notional</i>	<i>Notional</i>
<b><u>FY 2015</u></b>	<b><u>FY 2016</u></b>	<b><u>FY 2017<sup>1</sup></u></b>	<b><u>FY 2018<sup>2</sup></u></b>	<b><u>FY 2019</u></b>	<b><u>FY 2020</u></b>	<b><u>FY 2021</u></b>
<b>\$642M</b>	<b>\$640M</b>	<b>\$790M</b>	<b>\$846M</b>	<b>\$1,060M</b>	<b>\$1,173M</b>	<b>\$1,287M</b>

NASA's FY 2017 budget provides \$790 million to the Aeronautics Research Mission Directorate to implement its visionary strategy. The Aeronautics budget is supplemented by \$3.7B in mandatory funding over ten years to accelerate the realization of low carbon air transportation as part of a multiagency plan for a 21<sup>st</sup> century clean transportation system.

- \$159 million for the Airspace Operations and Safety Program to develop and explore new technologies that increase efficiency of the Nation's air traffic management systems reducing flight delays and fuel consumption.
  - Conducts a series of air traffic management technology demonstrations to validate the benefits of new concepts.
  - Provides leading edge research into increasingly autonomous aviation systems, including innovation in the management of Unmanned Aircraft System (UAS) traffic.
  - Pioneers real-time integration and analysis of data to support system-wide safety assurance, enabling proactive and prognostic aviation safety assurance.
- \$299 million for the Advanced Air Vehicles Program to develop the tools, technologies, and concepts that enable new generations of civil aircraft that are safer and more energy efficient.
  - Enables revolutionary advances in energy efficiency and environmental compatibility of future generations of aircraft.
  - Develops and validates tools and technologies that will lead to a more efficient vertical lift vehicles.
  - Develops technologies that will eliminate the barriers to commercial supersonic flight.
  - Maintains NASA's unique hypersonic capability for national needs.
  - Continues work on reducing the timeline for development and certification of innovative advanced composite materials and structures.
  - Sustains and advances key national testing capabilities that support aeronautics research.
- \$210 million for the Integrated Aviation Systems Program to conduct experimental flight research and major demonstrations of transformative innovation.
  - Contributes flight-validated data and capabilities that reduce technical barriers related to the safety and operational challenges associated with enabling routine civil UAS access to the NAS.
  - Conducts flight research on the most promising concepts and technologies at an integrated system level.
  - Establishes a major new flight initiative, New Aviation Horizons, to develop a continuing series of X-Planes and X-Systems to provide large scale testing of new technologies that will dramatically reduce fuel consumption, noise, and emissions and open new markets for U.S. industry. The initiative includes projects that will demonstrate a hybrid wing body aircraft, hybrid electric aircraft, and a quiet supersonic aircraft.
- \$122 million for the Transformative Aeronautics Concepts Program to cultivate multi-disciplinary, revolutionary concepts to enable aviation transformation and harnesses convergence in aeronautics and non-aeronautics technologies to create new opportunities in aviation.
  - Evaluates initial feasibility of internally and externally originated concepts to support the discovery and development of new, transformative solutions to challenges in aviation.
  - Supports research and development of major advancements in cross-cutting computational tools, methods, and single discipline technologies to advance research capabilities.
  - Creates a University Innovation and Challenge project to establish university leadership in developing transformative concepts and addressing key technical challenges facing the aviation industry.

<sup>1</sup> FY 2017 reflects discretionary and mandatory funding. Additional details on the mandatory funding can be found in the Congressional Justification.

<sup>2</sup> FY2018 – FY2021 include Mandatory Funding in the Aeronautics account supporting the Clean Transportation Initiative.

## NASA FY 2017 Budget Request for Space Technology

<u>Actuals</u>			<i>Notional</i>	<i>Notional</i>	<i>Notional</i>	<i>Notional</i>
<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017<sup>1</sup></u>	<u>FY 2018</u>	<u>FY 2019</u>	<u>FY 2020</u>	<u>FY 2021</u>
<b>\$600M</b>	<b>\$687M</b>	<b>\$827M</b>	<b>\$704M</b>	<b>\$719M</b>	<b>\$733M</b>	<b>\$748M</b>

The FY 2017 request is \$827 million to fund rapid development and incorporation of transformative space technologies that enable NASA's missions and address aerospace industry challenges. Space Technology drives exploration by engaging the brightest minds on the toughest technological challenges, spurring innovation throughout the aerospace enterprise. The budget request provides:

- \$579.4 million for Space Technology Research and Development investments to:
  - Continue on-going, in-space demonstrations of crosscutting technologies including: deep space atomic clock for advanced navigation and outer planetary science investigations; green propellant alternative to hydrazine for safer, more affordable spacecraft; and up to four small spacecraft demonstrations of pioneering new technologies.
  - Complete design and initiate hardware fabrication to support a late CY 2019 in-space demonstration of space-to-ground laser communications.
  - Transform the ability to observe the universe to answer profound questions in earth and space sciences by investing in foundational technologies that support: landing and mobility, navigation and communications, radiation protection and accommodating power needs, particularly applicable to understanding Europa's under ice liquid water oceans.
  - Continue formulation activities for a full-scale in-space demonstration of on-orbit robotic satellite servicing.
  - Advance spacecraft technologies such as life-support, thermal management, and thermal protection system, and surface systems technologies such as in-situ resource utilization and power generation enabling deep-space human exploration missions
  - Initiate a new in-space demonstration project to provide high bandwidth communications capabilities for future robotic and human deep space exploration missions..
  - Advance NASA's ability to access and travel through space by developing a high-powered solar electric propulsion capability to enable orbit maneuvering for satellites, accommodate increasing power demands for satellites, and for future exploration missions including Mars. NASA plans to incorporate high power Solar Electric Propulsion technology in the robotic segment of the asteroid redirect mission.
  - Collaborate with other government agencies and industry partners to mature high performance spaceflight computing hardware, robotics for extreme environments, and advanced manufacturing.
  - Continue development of fast transit in-space propulsion technologies that will make deep space exploration more feasible, efficient and affordable and advanced optical communication systems enabling high-bandwidth deep-space communication.
  - Continue a steady cadence of new technology activities conducted by the NASA workforce, academia, and businesses large and small within the aerospace industry, ensuring a healthy pipeline of innovations to enhance and enable NASA's future missions.
  
- \$213.0 million for the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs to support research and development performed by small businesses through competitively awarded contracts, utilizing small businesses to spark new ideas for the benefit of NASA, US aerospace and high tech industries.
  
- \$34.3 million for Agency Technology and Innovation, which:
  - Provides strategy, leadership, and coordination that guides NASA technology and innovation
  - Spurs innovation by providing Agency-level leadership and coordination of the use of prizes and competitions, including the Asteroid Grand Challenge.
  - Leads technology transfer and commercialization activities across the agency, extending the benefits of NASA's technology investments so they have a direct and measurable impact on daily life.

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## NASA FY 2017 Budget Request for Human Exploration Operations

<b>Actuals</b>			<i>Notional</i>	<i>Notional</i>	<i>Notional</i>	<i>Notional</i>
<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017<sup>1</sup></u>	<u>FY 2018</u>	<u>FY 2019</u>	<u>FY 2020</u>	<u>FY 2021</u>
<b>\$8,168M</b>	<b>\$9,059M</b>	<b>\$8,413M</b>	\$8,443M	\$8,611M	\$8,784M	\$8,959M

The FY 2017 budget requests \$8,413 million (\$3,337 million for Exploration and \$5,076 million for Space Operations).

- \$1,431 million for the International Space Station (ISS). As the world's only crewed space-based multinational research laboratory and technology test bed, ISS is critical to the future of human exploration beyond low Earth orbit.
  - Enables scientists to identify and quantify risks to human health and performance, develop countermeasures, and develop and test technologies that protect astronauts during extended human space exploration.
  - Supports unique research and development opportunities in the areas of biological and physical processes.
  - Maintains the ISS international partnership that has transformed space exploration from an effort for the advancement of individual nations to an endeavor for the betterment of humankind.
  - Supports current and planned Earth and Space Science observation missions.
- \$2,758 million for Space Transportation
  - Continues NASA's partnership with U.S. commercial space industry to develop and operate safe, reliable, and affordable systems to transport crew to and from the ISS and low Earth orbit. This activity will allow for increased ISS research by providing an additional crewmember, and will provide rescue capability for the crew on the ISS. This strategy assures U.S. access to the ISS, bolsters American leadership, and reduces our reliance on foreign providers.
  - Sustains NASA's ISS cargo supply function with American private industry.
- \$887 million for Space and Flight Support
  - Continues providing mission critical space communications and navigation services to customer missions, including human, science, and commercial crew and cargo missions.
  - Continues support to the modernization of the Space Network.
  - Planning launch of Tracking and Data Relay Satellite (TDRS)-M in 2017.
  - Supports the readiness and health of the crew for all NASA human space flight endeavors.
  - Provides safe, reliable, and cost-effective launch services for six NASA payloads in FY 2017 and gives launch-related support to over 40 NASA scientific spacecraft missions in various phases of development. Continues to strategically manage NASA's rocket testing core capability to meet U.S. rocket testing requirements.
- \$2,860 million for Exploration Systems Development
  - Continues development of the Orion Crew Vehicle, Space Launch System (SLS), and Exploration Ground Systems (EGS) that will send astronauts on deep space exploration missions. In FY 2017, both SLS and Orion will increase the manufacturing of components for the first Exploration Mission (EM-1). SLS will integrate the first core stage and prepare it for testing, while Orion will begin assembly, integration and testing of the EM-1 Crew module.
  - EGS will continue to prepare launch infrastructure and operations requirements in support of the SLS and Orion programs. Modifications to existing facility and command and control systems will be ongoing.
- \$477 million for Exploration Research and Development
  - Advanced Exploration Systems (AES) will develop foundational technologies for future exploration missions. Major products include systems development for reliable life support, cis-lunar space habitation capability, crew mobility systems, public-private partnerships for lander capabilities, in-space in-situ resource utilization capabilities, autonomous space operations, and Asteroid Redirect Mission work which all enable future human missions beyond Earth orbit, while reducing life cycle costs of future explorations systems. Human Research Program continues to understand and mitigate the highest risks to astronaut health and performance to ensure that crews remain healthy and productive during long-duration missions beyond low-Earth orbit.

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## NASA FY 2017 Budget Request for Education

<u>Actuals</u>		<u>FY 2017<sup>1</sup></u>	<i>Notional</i>	<i>Notional</i>	<i>Notional</i>	<i>Notional</i>
<u>FY 2015</u>	<u>FY 2016</u>	<u>\$100M</u>	<u>FY 2018</u>	<u>FY 2019</u>	<u>FY 2020</u>	<u>FY 2021</u>
<b>\$119M</b>	<b>\$115M</b>	<b>\$100M</b>	<b>\$102M</b>	<b>\$104M</b>	<b>\$106M</b>	<b>\$108M</b>

The FY 2017 budget requests \$100 million for the Education program.

- Continues to restructure the Agency’s education efforts to better align to the principles of the Administration’s STEM reorganization and Five-Year Federal Strategic Plan on STEM Education.
- Maintains the Agency’s investment in the Aerospace Research and Career Development (ARCD) program to support Space Grant and Experimental Program to Stimulate Competitive Research (EPSCoR).
  - - \$24 million for Space Grant, a nationwide network of colleges, universities, and other organizations that provide NASA space-related opportunities to learners, educators, and the public.
    - \$9 million for EPSCoR, which provides competitive NASA-related research opportunities to institutions in eligible states.
- Provides \$67 million for the STEM Education and Accountability (SEA) program to support the Minority University Research and Education Project (MUREP) and STEM Education and Accountability Projects (SEAP).
  - \$30 million for MUREP, which provides financial assistance (internships, scholarships, and fellowships grants and cooperative agreements) to the Nation’s Historically Black Colleges and Universities (HBCUs), Hispanic Serving Institutions (HSIs), Asian American and Native American Pacific Islander-Serving Institutions (AANAPISIs), Tribal Colleges and Universities (TCUs) and eligible community colleges as required by the four Minority Serving Institutions (MSIs) Executive Orders.
  - \$37 million for SEAP to support, through a competitive process, the best application of unique NASA assets, missions, and discoveries to advance the Administration’s education goals. NASA will continue to work with other agencies to support the goals articulated in the Five-Year Federal Strategic Plan on STEM Education.
  - Continues the ARCD and SEA programs’ competitive, evidence-based projects to contribute to the infrastructure necessary to support the rigorous collection, evaluation, and dissemination of evidence of NASA’s contributions towards the achievement of the Agency’s strategic plan and the wider Administration STEM goals.
- Maintains a more focused portfolio of education efforts funded through the Office of Education. Continues to internally consolidate some functions, assets and efforts previously funded Human Exploration and Operations Mission Directorate, Aeronautics Research Mission Directorate, and Cross Agency Support Accounts.

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## NASA FY 2017 Budget Request for Safety, Security, and Mission Services

<u>Actuals</u> <u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017<sup>1</sup></u>	<i>Notional</i> <u>FY 2018</u>	<i>Notional</i> <u>FY 2019</u>	<i>Notional</i> <u>FY 2020</u>	<i>Notional</i> <u>FY 2021</u>
<b>\$2,755M</b>	<b>\$2,769M</b>	<b>\$2,837M</b>	<b>\$2,894M</b>	<b>\$2,952M</b>	<b>\$3,010M</b>	<b>\$3,071M</b>

The FY 2017 budget provides \$2,837 million for Safety, Security, and Mission Services. NASA will continue to seek additional operational efficiencies across the Agency, including Center and Headquarters services. The budget request provides:

- \$2,018 million for Center Management and Operations to fund ongoing management, operations, and maintenance of NASA Centers and associated component facilities, including:
  - \$1,564 million to provide the basic support required to meet internal and external requirements; effectively manage human capital, information technology, and facility assets; responsibly execute financial management and acquisition responsibilities; and provide a safe, secure, and environmentally sustainable workplace.
  - \$454 million for technical facilities, workforce expertise and skills, equipment, and other resources required to implement the program at the center and ensure engineering and safety oversight of NASA programs.
- \$819 million for Agency Management and Operations to fund the management and oversight of Agency missions, programs and functions, and performance of NASA-wide mission support activities, including:
  - \$378 million for Agency Management to support executive-based, Agency-level functional and administrative management requirements and for the operational activities of Headquarters as a center.
  - \$170 million for Safety and Mission Success activities required to reduce the risk, loss of life and/or mission, in our manned and unmanned programs, including engineering; safety and mission assurance; independent health and medical oversight; and independent software verification and validation.
  - \$244 million for Agency Information Technology Services, to provide mission-enabling IT capabilities, risk-based cyber security, and a sustainable management approach to support NASA's diverse mission needs; and, to invest in critical IT infrastructure and enterprise solutions supporting modernization of Agency systems, increased automation, and optimization of enterprise-wide IT service solutions.
  - \$27 million for the Strategic Capabilities Assets Program to provide the skilled workforce and essential preventive maintenance to keep core test facilities available to meet the current and future Agency needs and to ensure core test facilities are in a state of readiness.

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## NASA FY 2017 Budget Request for

### Construction and Environmental Compliance and Restoration

<u>Actuals</u>			<i>Notional</i>	<i>Notional</i>	<i>Notional</i>	<i>Notional</i>
<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017<sup>1</sup></u>	<u>FY 2018</u>	<u>FY 2019</u>	<u>FY 2020</u>	<u>FY 2021</u>
\$446M	\$389M	\$420M	\$390M	\$398M	\$406M	\$414M

The FY 2017 budget provides \$420 million for Construction and Environmental Compliance and Restoration (CECR), and includes funds realigned from mission directorate budgets to effect statutory direction to fund programmatic construction projects in the CECR account. The budget provides:

- \$291 million for Institutional Construction of Facilities to fund capital repairs and improvement to ensure that center infrastructure critical to achieving NASA's space and aeronautics programs are safe, secure, environmentally sound, and operate efficiently. NASA seeks to achieve a sustainable and energy-efficient infrastructure by replacing old, inefficient, deteriorated buildings with new, efficient, high-performance buildings while reducing our footprint. This budget includes \$47 million to construct the Ames Research Center Biosciences Collaborative Facility. This science laboratory will consolidate laboratory and research in a modern facility to support the agency's biological research.
- \$37 million for Programmatic Construction of Facilities projects to carry out specific Exploration Systems and Space Operations programmatic requirements in FY 2017. Funding in this category was realigned from the mission directorates to the CECR budget to effect Congressional direction that all NASA construction projects be funded in the CECR account. The FY 2017 request for Programmatic Construction of Facilities includes funding to achieve Space Launch System, Orion, Exploration Ground Systems, and Space Communications and Navigation requirements. Funding associated with all program designs and out-year programmatic construction activities remains in program accounts.
- \$92 million for Environmental Compliance and Restoration to support cleanup of hazardous materials and waste released to the surface or groundwater at NASA installations, NASA-owned industrial plants supporting NASA activities, current or former sites where NASA operations contributed to environmental problems, and other sites where the Agency is legally obligated to address hazardous pollutants.

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