

FY2018 Budget Request

Science

(\$ Millions)

	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
Science	5,584.1	5,764.9	5,711.8	5,728.7	5,728.7	5,728.7	5,728.7
Earth Science			1,754.1				
Planetary Science			1,929.5				
Astrophysics			816.7				
James Webb Space Telescope		569.4	533.7				
Heliophysics			677.8				

- Includes five major science areas
 - Planetary Science to explore the planetary bodies of our solar system. Included is funding for a mission to Jupiter's moon Europa, for the InSight and Mars 2020 missions, the recently selected Lucy and Psyche missions, the next New Frontiers mission, and radioisotope power systems for deep space missions.
 - Astrophysics to study the universe and search for Earth-like planets, including WFIRST, TESS, and the recently selected IXPE and GUSTO missions.
 - James Webb Space Telescope on track for launch in 2018.
 - Heliophysics to study the Sun and its influence throughout the solar system, including launch of Solar Probe Plus in 2018 and the Solar Orbiter Collaboration with ESA in 2019.
 - Earth Science to improve modeling of Earth as a system, weather prediction, and natural hazard mitigation by making observations of the land, atmosphere, and oceans from spacecraft and suborbital platforms. Supports ongoing work on 14 current missions in formulation and development, routine selections of new Venture Class projects, and funding to increase the capabilities and uses of Cubesats and multi-spacecraft constellations of small scientific satellites.
 - Terminates five Earth science missions: PACE, OCO-3, RBI, DSCOVR Earth-viewing instruments, and CLARREO Pathfinder.
- Supports about 100 space missions
 - About 40 missions currently preparing for launch and about 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 did our solar system originate and change over time?
 - How did life originate, and are we alone?
 - How and why are Earth's climate and the environment changing?
 - How did the universe begin and evolve, and what will be its destiny?
 - What drives variations in the Sun, and how do these changes affect the solar system and drive space weather?
- Invests in developing advanced technologies
 - Providing novel partnership opportunities between commercial partners and NASA through a CubeSat/SmallSat initiative targeted at specific high-priority science goals.
 - Developing optics and detectors to find planets around other stars, instruments to look for signs of past or present life on Mars and other planetary bodies, and 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.
 - 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 and improving quality of life via high-tech jobs and new technologies.
 - Assisting responses to national and international disasters.

FY2018 Budget Request

Aeronautics

(\$ Millions)

	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
Aeronautics	633.8	660.0	624.0	624.4	624.4	624.4	624.4
Airspace Operations and Safety Program			108.7				
Advanced Air Vehicles Program			232.7				
Integrated Aviation Systems Program			173.5				
Transformative Aero Concepts Program			109.2				

This budget will be used to conduct aeronautics research to bring transformational advances in the safety, capacity, and efficiency of the air transportation system and to sustain U.S. technological leadership in the aviation industry. NASA developed a strategic vision that focused its Aeronautics research to best contribute to the nation's future societal and economic vitality. To reach this vision, NASA's Aeronautics research has been aligned to focus on defined strategic thrust areas. The budget request supports four distinct programs within the Agency's aeronautics portfolio:

- **Airspace Operations and Safety Program** to develop and explore fundamental concepts, algorithms, and technologies to increase throughput and efficiency of the National Airspace System (NAS) safely. The program works in close partnership with the FAA and the aviation community to enable and extend the benefits of NextGen, the Nation's program for modernizing and transforming the NAS to meet evolving user needs. The program is on the leading edge of research into increasingly autonomous aviation systems, including innovation in the management of UAS traffic and other novel aviation vehicles. The program is also pioneering the real-time integration and analysis of data to support system-wide safety assurance, enabling proactive and prognostic aviation safety practices.
- **Advanced Air Vehicles Program** to develop the tools, technologies, and concepts that enable new generations of civil aircraft that are safer, more energy efficient, and have a smaller environmental footprint. The program researches technologies to enable major leaps in the safety, efficiency, and environmental performance of subsonic fixed and rotary wing aircraft to meet growing long-term civil aviation needs; pioneers low-boom supersonic flight to achieve new levels of global mobility; and sustains hypersonic competency for national needs. The program works in close partnership with academia and industry to pioneer fundamental research and to mature the most promising technologies and concepts for transition to the aviation industry. The program also works on reducing the timeline for development and certification of innovative advanced composite materials and structures. The program sustains and advances key national testing capabilities that support aeronautics research and development.
- **Integrated Aviation Systems Program** to focus on experimental flight research and the spirit of integrated, technological risk taking that can demonstrate transformative innovation. The program includes New Aviation Horizon X-plane projects, starting with a low boom flight demonstrator project that will pave the way for eventual over-land commercial supersonic flight. The program complements both the Airspace Operations and Safety Program and the Advanced Air Vehicle Program by conducting research on the most promising concepts and technologies at an integrated system level. The program explores, assesses, and demonstrates the benefits of these potential technologies in a relevant environment. The program works in partnership with the other Aeronautics programs, academia, the aviation industry, and international partners as appropriate.
- **Transformative Aeronautics Concepts Program** to cultivate multi-disciplinary, revolutionary concepts to enable aviation transformation and harness convergence in aeronautics and non-aeronautics technologies. The program's goal is to demonstrate initial feasibility of internally and externally originated concepts supporting the discovery and development new transformative solutions supporting the NASA Aeronautics strategy. The program enables university leaders to pursue transformative concepts to overcome barriers facing the aviation industry through the University Leadership Initiative. The program also supports

research and development of major advancements in cross-cutting computational tools, methods, and single discipline technologies to advance the research capabilities of all Aeronautics programs.

FY2018 Budget Request

Space Technology

(\$ Millions)

	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
Space Technology	686.4	686.5	678.6	679.3	679.3	679.3	679.3
Space Technology Research & Development			466.7				
SBIR and STTR			180.0				
Agency Technology and Innovation			31.9				

Space Technology drives exploration by engaging the brightest minds on the toughest technological challenges, spurring innovation throughout the aerospace enterprise.

- **Space Technology Research and Development:**

- Performs in-space demonstrations of crosscutting technologies including: deep space atomic clock for advanced navigation; a safer, higher performing propellant alternative to hydrazine; and up to three small spacecraft demonstrations of pioneering new technologies.
- *Expands utilization of near-Earth space* through satellite servicing and small launch vehicle technology development.
- *Develops efficient and safe transportation through space* with development of a high-powered solar electric propulsion system to enable orbit maneuvering for satellites, accommodate increasing power demands for satellites, and support future exploration missions including Mars.
- *Increases access to planetary surfaces* through entry, decent, and landing technologies including thermal protection systems, deployable aeroshells and propulsive decent technologies.
- *Enables humans to live and explore in deep space* by advancing technologies such as life-support, thermal management, and surface systems technologies such as in-situ resource utilization and power generation enabling deep-space human exploration missions.
- *Enables the next generation of Science missions* through development and demonstration of Deep Space Optical Communications, and the design and initial fabrication to support a late CY 2019 in-space demonstration of space-to-ground laser communications, radiation hardened electronics and energy storage for Ocean Worlds surface missions, adaptive optics for direct exo-planet imaging, and extreme environment solar power for deep space missions.
- *Collaborate with other government agencies and industry partners* to mature high performance spaceflight computing hardware, robotics for extreme environments, and in-space robotic manufacturing and assembly. Notably, the budget restructures a duplicative robotic satellite refueling demonstration mission to reduce its cost and better position it to support a nascent commercial satellite resupplying industry.
- *Grows and utilizes the U.S. industrial and academic base* with a steady cadence of early stage technology activities conducted by the NASA workforce, academia, and businesses large and small within the aerospace industry, ensuring development of the innovations and technologies required to enable NASA's future missions.

- **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, U.S. aerospace and high tech industries.

- **Agency Technology and Innovation:**

- 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.
- 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.



FY2018 Budget Request

Human Exploration and Operations

(\$ Millions)

	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
Human Exploration and Operations	9,028.5	9,274.7	8,674.9	8,792.5	8,792.5	8,792.5	8,792.5
Space Operations			4,740.8				
International Space Station			1,490.6				
Space Transportation			2,415.1				
Space and Flight Support (SFS)			835.0				
Exploration			3,934.1				
Exploration Systems Development			3,584.1				
Exploration Research and Development			350.0				

The FY 2018 PBR includes a transfer to CECR account to support modifications required to Kennedy Space Center facilities for Exploration Upper Stage and MAF repairs.

- **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 deep space human exploration.
- Promotes commerce in space through public-private partnerships as new commercialization concepts are explored.
- Advances exploration of the solar system and 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 sciences 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.

- **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 crew member. This strategy will lay the foundation for more affordable and sustainable future human space transportation capabilities, bolster American leadership, reduce our current reliance on foreign providers for this service, and help stimulate the American aerospace industry.
- Sustains NASA's ISS cargo supply function in partnership with American private industry.
- Continues to advance commercial spaceflight and the American jobs it creates.

- **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 to modernize of the Space Network.

- Continues to advance next generation near Earth (TDRS system replacement) and deep space (Mars network) architecture options, incorporating new capabilities for on-demand services, Delay/Disruption Tolerant networking, and autonomous navigation
 - Infuses new technologies like optical communication to enable significant reductions in system acquisition and operations cost while improving network flexibility, scalability, and security.
 - Supports the readiness and health of the crew for all NASA human spaceflight endeavors.
 - Provides safe, reliable, and cost-effective launch services for five civil sector missions in FY 2018, as well as 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.
- **Exploration Systems Development (ESD)**
 - ESD programs are creating the first components of an architecture that supports human exploration beyond low Earth orbit. Orion, Space Launch System (SLS) and Exploration Ground Systems (EGS), which supports their integration and launch, will take us to cislunar space. In cislunar space NASA will conduct deep-space missions to test systems and concepts, paving the way for long-duration human space exploration while conducting research.
 - The Orion program will continue final assembly and testing of the EM-1 crew vehicle at KSC.
 - The SLS rocket's production and certification for flight will continue at MAF, and MSFC and engine testing will continue at SSC. Key rocket components will deliver to EGS at KSC for integration into the final flight launch vehicle with the Orion crew vehicle.
 - 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.
 - NASA will explore approaches for reducing the costs of exploration missions to enable a more expansive exploration program.
- **Exploration Research and Development**
 - Advanced Exploration Systems uses a combination of unique in-house activities and public-private partnerships to develop and test high-priority capabilities and prototype systems that will form the basis for robotic and human deep space missions. Activities focus on robotic precursor missions that address knowledge gaps related to potential human destinations, advanced in-space propulsion, landing capabilities, in-situ resource prospecting and processing, reliable life support, deep space habitation technologies, and capabilities to reduce future logistics requirements.
 - Human Research Program fosters a national space biomedical research program that investigates the greatest risks to astronaut health and performance. The program develops essential mitigation countermeasure and technologies to ensure that crews remain healthy and productive in the challenging environment of space during long-duration missions beyond low-Earth orbit.

FY2018 Budget Request

Safety, Security, and Mission Services

(\$ Millions)

	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
Safety, Security, and Mission Services	2,772.4	2,768.6	2,830.2	2,859.4	2,859.4	2,859.4	2,859.4
Center Management and Operations			1,992.5				
Center Institutional Capabilities			1,533.3				
Center Programmatic Capabilities			459.2				
Agency Management and Operations			837.7				
Agency Management			361.2				
Safety and Mission Success			171.4				
Agency IT Services (AITS)			278.1				
Strategic Capabilities Asset Program			27.0				

Directly enables NASA's portfolio of missions in aeronautics and space exploration. The FY 2018 request provides the operations, tools, equipment, and capabilities to safely operate and maintain NASA centers and facilities and the independent technical authority required to reduce risk to life and program objectives for all NASA missions.

- **Center Management and Operations** fund ongoing management, operations, and maintenance of NASA Centers and associated component facilities, including:
 - **Center Institutional Capabilities** 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.
 - **Center Programmatic Capabilities** provide 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.
- **Agency Management and Operations** fund the management and oversight of Agency missions, programs and functions, and performance of NASA-wide mission support activities, including:
 - **Agency Management** supports executive-based, Agency-level functional and administrative management requirements and for the operational activities of Headquarters as a center.
 - **Safety and Mission Success** activities are 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.
 - **Agency Information Technology Services** 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. The FY 2018 request increases Agency IT Services to strengthen cybersecurity capabilities and safeguard critical systems and data. It includes investments in critical IT infrastructure and enterprise solutions. Funding will support modernizing Agency systems, increased automation, and optimized delivery of enterprise-wide IT service solutions.

- **Strategic Capabilities Assets Program** 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.

Construction & Environmental Compliance and Restoration

(\$ Millions)

	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
Construction & Envrmtl Compl Restoration	427.4	360.7	496.1	368.6	368.6	368.6	368.6
Construction of Facilities			408.2				
Institutional CoF			280.7				
Programmatic CoF			127.5				
Environmental Compliance and Restoration			87.9				

Directly enables NASA's portfolio of missions in aeronautics and space exploration. With installations in 14 states, we collectively manage \$39 billion in constructed assets with an inventory of over 5,000 buildings and structures. Our focus is on renewing and sustaining only what is crucial to mission success and divesting of unneeded older, costly real property to lower the cost of operations. The budget provides:

- 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. In addition to critical repair projects, the FY 2018 budget provides \$41.3 million to construct the Goddard Space Flight Center Instrument Development Facility. This state of the art facility replaces obsolete facilities to enable the development of new instruments and technology in support of Science missions. Construction of the \$35.3 million Glenn Research Support Building will also replace obsolete facilities, consolidating research spaces into a smaller more efficient footprint. The request also provides \$16 million to begin restoration of the Kennedy Space Center shoreline. Restoration of the shoreline is essential to protect critical launch operations from inland flooding which would halt operations.
- Programmatic Construction of Facilities** projects to carry out specific Science, Exploration Systems, and Space Operations programmatic requirements. 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. Projects include \$90.1 million for modifications required to Kennedy Space Center facilities for Exploration Upper Stage, \$14.8 million to improve reliability of NASA's Deep Space Network, and \$15 million for the Modular Supercomputing Facility at Ames Research Center. Funding associated with all program designs and out-year programmatic construction activities remains in program accounts.
- 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.

