National Aeronautics and Space Administration

FISCAL YEAR 2016

BUDGET ESTIMATES

REACH NEW HEIGHTS

BENEFIT ALL HUMANKIND

REVEAL THE UNKNOWN

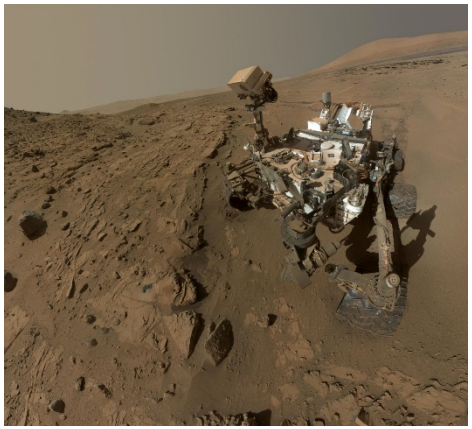
2016 Budget Highlights

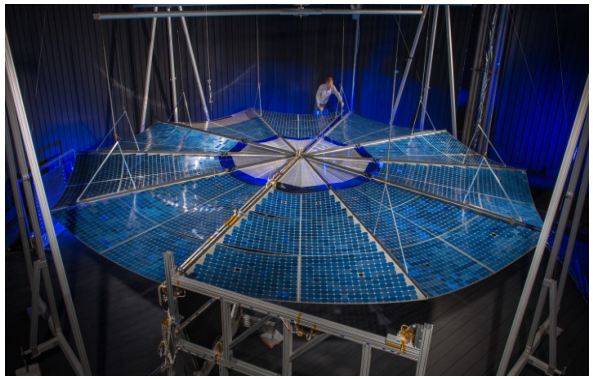
- Builds on U.S. preeminence in science and technology, improves life on Earth and protects our home planet, while creating jobs and strengthening the American economy.

- Provides $18.5 billion to advance the Nation's space exploration plan and ensure that the United States remains the world's leader in space exploration and scientific discovery for years to come.

- Supports the growth of a vibrant American commercial space industry and partners with industry to regain the capability to send astronauts into space cost-effectively and safely from American soil by the end of 2017.

- Invests in space technologies that enhance current US space capabilities while improving our ability to access and travel through space; accurately land more mass in more locations throughout the solar system; live and work in deep space and on planetary bodies; and transform the ability to observe the universe and answer profound questions in earth and space sciences.



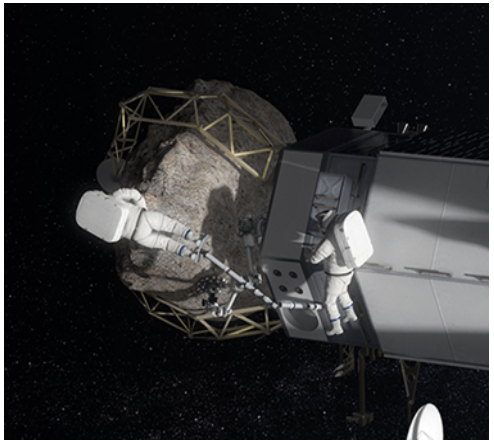


Highlights *(continued)*

- Continues development of the Orion Multi-Purpose Crew Vehicle, Space Launch System (SLS), and Exploration Ground Systems (EGS) that will send astronauts on deep space exploration missions.

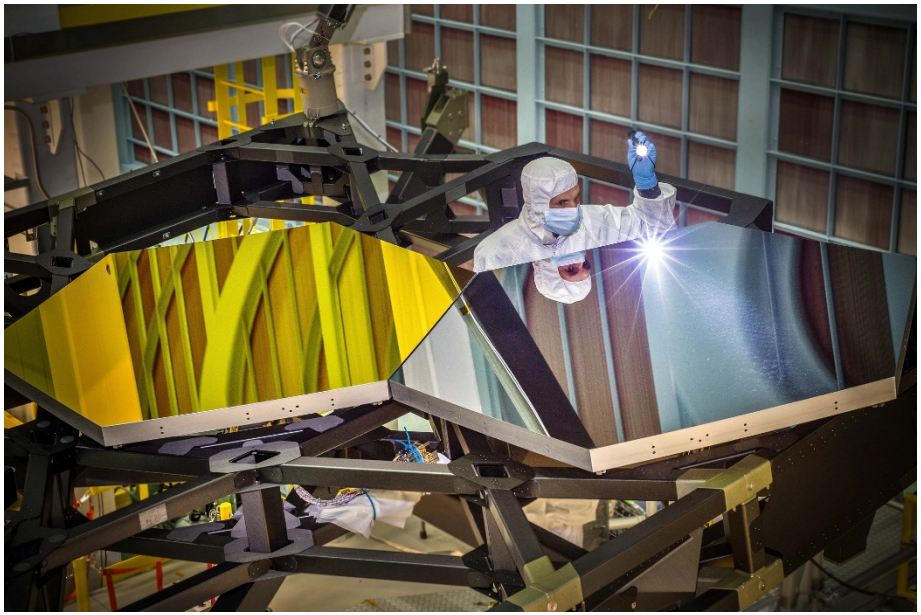
- A crewed mission to rendezvous with a redirected asteroid in cis-lunar space will allow NASA to expand crewed operations beyond low Earth orbit as a proving ground for Mars class missions.

- Extends operation of the International Space Station (ISS) to at least 2024, providing a unique environment for research on human health and space operations necessary for future long-term human missions, for expanding commercial activity in low Earth orbit, and providing direct benefits to the people of Earth.

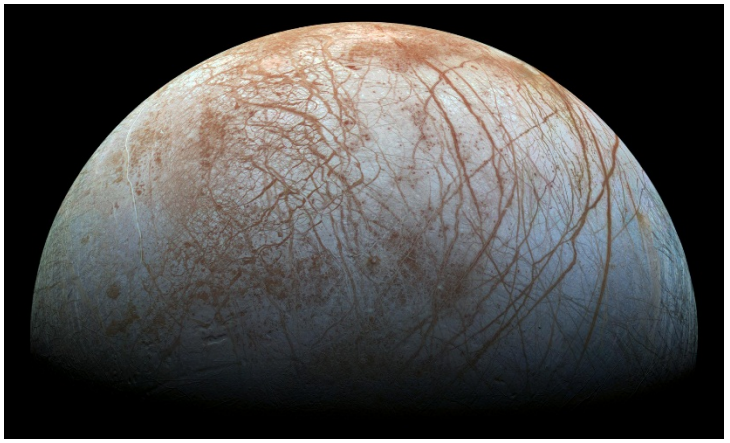


Highlights *(continued)*

- Funds achievement of multiple milestones in the development, integration, and testing of our next Great Observatory the James Webb Space Telescope, planned for launch in 2018.



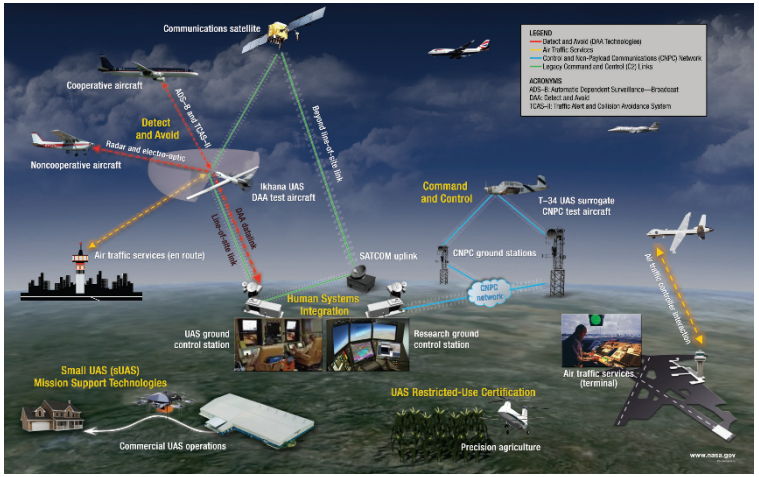
- Funds crucial satellite and research efforts to help us understand the Earth's systems and climate, and continue the 42-year Landsat record of global land-imaging measurements.



- Funds missions to Mars, Europa, and other destinations throughout the solar system, and supports the Discovery and New Frontiers programs.

Highlights *(continued)*

- Focuses aeronautics research on the community-endorsed strategy to address a growing demand for mobility, severe challenges to sustainability of energy and the environment, and technology advances in information, communications, and automation technologies. Continues research supporting the implementation of NextGen and the development of environmentally responsible air vehicles.

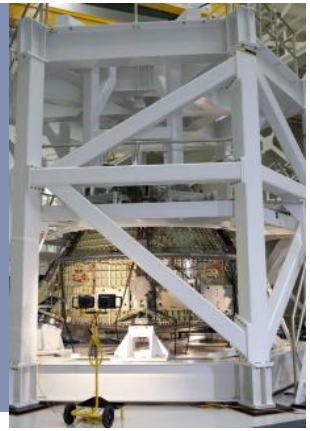


- Funds aeronautics technology development to address emerging needs such as integration of Unmanned Aircraft Systems (UAS) into the NAS, enabling small UAS operations at low altitude, and low carbon propulsion.

- Contributes to the government-wide effort to improve the delivery and effectiveness of STEM education programs. Supports a more cohesive infrastructure for delivering STEM education and leveraging existing resources to improve the reach of agency assets.

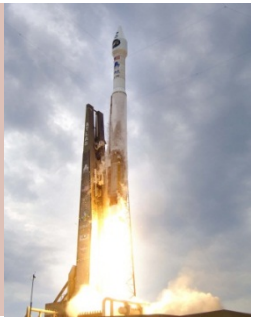
Anticipated Accomplishments in FY 2016

SLS/Orion: Complete structural build of major components and begin testing



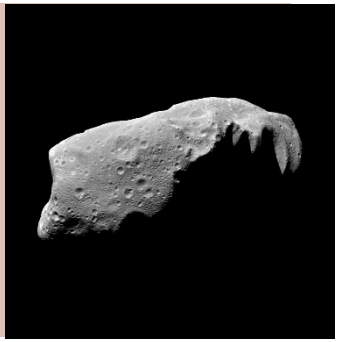
ISS: Increase utilization with science and technology payload hardware to 70 percent; Complete the One-year crew increment

Launch 13 science and cargo missions and one commercial crew test



Commercial Crew Program: Conduct Commercial Crew transportation system test flight and other milestones

Asteroid Redirect Mission: Complete definition of the ARM robotic mission segment



JWST: Integrate the JWST mirror with science instruments (cameras and spectrographs)

Aeronautics: Complete Capstone UAS flight demo to deliver 5 years of results; enable FAA regulations on integration

Space Tech: Transform technology with six major in-space demos

FY 2016 Budget Request ($M)

				Notional			
	FY 2014 Op Plan*	FY 2015 Enacted**	FY2016	FY2017	FY2018	FY2019	FY2020
Science	$5,148.2	$5,244.7	$5,288.6	$5,367.9	$5,448.4	$5,530.2	$5,613.1
Earth Science	$1,824.9		$1,947.3	$1,966.7	$1,988.0	$2,009.3	$2,027.4
Planetary Science	$1,345.7		$1,361.2	$1,420.2	$1,458.1	$1,502.4	$1,527.8
Astrophysics	$678.3		$709.1	$726.5	$769.5	$1,005.5	$1,138.3
James Webb Space Telescope	$658.2		$620.0	$569.4	$534.9	$305.0	$197.5
Heliophysics	$641.0		$651.0	$685.2	$697.9	$708.1	$722.1
Aeronautics	$566.0	$651.0	$571.4	$580.0	$588.7	$597.5	$606.4
Space Technology	$576.0	$596.0	$724.8	$735.7	$746.7	$757.9	$769.3
Exploration	$4,113.2	$4,356.7	$4,505.9	$4,482.2	$4,298.7	$4,264.7	$4,205.4
Exploration Systems Development	$3,115.2	$3,245.3	$2,862.9	$2,895.7	$2,971.7	$3,096.2	$3,127.1
Commercial Spaceflight	$696.0	$805.0	$1,243.8	$1,184.8	$731.9	$173.1	$1.1
Exploration Research and Development	$302.0	$306.4	$399.2	$401.7	$595.1	$995.4	$1,077.2
Space Operations	$3,774.0	$3,827.8	$4,003.7	$4,191.2	$4,504.9	$4,670.8	$4,864.3
International Space Station	$2,964.1		$3,105.6	$3,273.9	$3,641.0	$3,826.0	$4,038.3
Space and Flight Support (SFS)	$809.9		$898.1	$917.3	$863.8	$844.8	$826.1
Education	$116.6	$119.0	$88.9	$90.2	$91.6	$93.0	$94.4
Safety, Security, & Mission Services	$2,793.0	$2,758.9	$2,843.1	$2,885.7	$2,929.1	$2,973.0	$3,017.5
Center Management and Operations	$2,041.5		$2,075.2	$2,105.0	$2,136.6	$2,168.6	$2,201.0
Agency Management and Operations	$751.5		$767.9	$780.7	$792.5	$804.4	$816.5
Construction & Envrmtl Compl Restoration	$522.0	$419.1	$465.3	$436.1	$442.6	$449.3	$456.0
Construction of Facilities	$455.9		$374.8	$344.3	$349.3	$354.6	$359.9
Environmental Compliance and Restoration	$66.1		$90.5	$91.8	$93.3	$94.7	$96.1
Inspector General	$37.5	$37.0	$37.4	$38.0	$38.5	$39.1	$39.7
Grand Total	**$17,646.5**	**$18,010.2**	**$18,529.1**	**$18,807.0**	**$19,089.2**	**$19,375.5**	**$19,666.1**

FY 2014 reflects funding amounts specified in the June 2014 Operating Plan per P.L. 113-76.

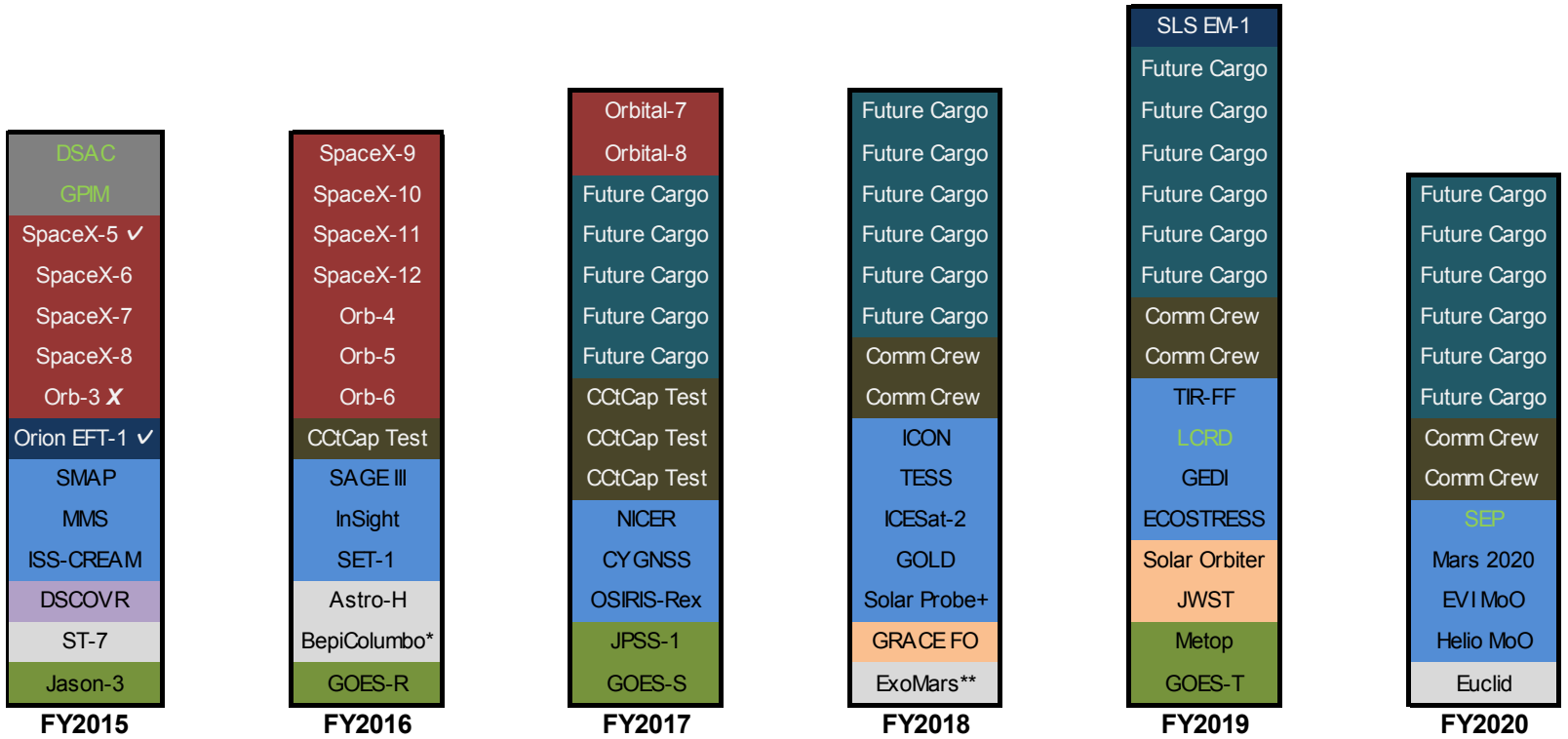
****FY 2015 reflects only funding amounts specified in P.L. 113-235, the Consolidated and Further Continuing Appropriations Act, 2015.***

NASA Mission Launches (Fiscal Years 2015 – 2020)

- NASA Mission on US ELV
- Reimbursable Mission for NOAA
- Joint NASA-NOAA-USAF Mission
- Joint NASA-Int'l Partner Mission
- Int'l Mission with NASA contribution
- Joint NASA-USAF Mission
- Exploration Systems Development Mission
- Commercial Orbital Transportation Services
- Commercial Crew Mission
- Commercial Resupply Services Mission
- Future Commercial Resupply Mission

✓ Mission successfully launched
X Mission unsuccessful
TDRS-M Launch service to be determined
HEO missions in white text
SMD missions in black text
STMD missions in green text
*NASA provided instrument is Strofio
**NASA provided instrument is MOMA-MS

*Dates reflect Agency Baseline Commitments or updated Agency schedules and may include schedule margin beyond any manifested launch dates



Earth Science

Outyears are notional

($M)	2016	2017	2018	2019	2020
Earth Science	$1,947	$1,967	$1,988	$2,009	$2,027

- Supports formulation and development of PACE, NISAR, OCO-3, ICESat-2, GRACE Follow-on, and SWOT.
- Multi-Decadal Sustainable Land Imaging (SLI) program provides high-quality, global land imaging measurements, involving Thermal-Infrared Free-Flyer (TIR-FF), Landsat 9 (fully Class-B rebuild of Landsat 8), and Land Imaging Technology and System Innovation.

- Transfers TSIS-1 and future ocean altimetry missions (after Jason-3) from NOAA to NASA, consistent with a revision of satellite responsibilities in which NOAA retains responsibility for weather satellites and NASA is the lead for other nondefense Earth-observing satellite missions.
- Supports the Venture Class Suborbital-2 investigation selections.
- Provides strong support for Research and Analysis.
- Operates 18 additional missions, and the Airborne Science project.

Planetary Science

Outyears are notional

($M)	2016	2017	2018	2019	2020
Planetary Science	$1,361	$1,420	$1,458	$1,503	$1,528

- Launches the InSight mission to Mars, the Strofio instrument to Mercury, and the OSIRIS-REx mission to visit an asteroid and return a sample.
- Continues development of the Mars 2020 mission.
- Funds formulation work for a mission to Jupiter's moon, Europa.
- Continues work on the JUICE instrument in collaboration with the European Space Agency mission to Jupiter.

Dawn Image of Ceres on January 13, 2015

- Operates 13 Planetary missions including MAVEN & MSL (Mars), and Cassini (Saturn).
- Increases funding for asteroid detection capabilities to identify and characterize potentially hazardous near-Earth objects.
- Supports the selection of the next Discovery mission from the 2015 Announcement of Opportunity and the next New Frontiers opportunity.

Astrophysics

Outyears are notional

($M)	2016	2017	2018	2019	2020
Astrophysics	$709	$727	$770	$1,006	$1,138

- Supports operating missions: SOFIA, Hubble, NuSTAR, Kepler, Spitzer, Chandra, Swift, and Fermi.
- Funds development of Explorer missions TESS and NICER. TESS will continue the search for exoplanets, scanning all of the sky for Exoplanets closer to Earth than those found by Kepler.
- Supports pre-formulation studies for WFIRST/AFTA.
- Maintains a competed astrophysics research program and support of the balloon program.

James Webb Space Telescope

Outyears are notional

($M)	2016	2017	2018	2019	2020
JWST	$620	$569	$535	$305	$198

- Supports the commitment of an October 2018 launch date.
- Will deliver the Integrated Science Instrument Module for integration;
- Completes integration of flight primary mirror subassemblies onto the flight primary mirror backplane;
- Completes acceptance testing of the cryocooler compressor assembly;
- Completes spacecraft bus structure; and
- Completes the sunshield structure manufacture and test.

Heliophysics

Outyears are notional

($M)	2016	2017	2018	2019	2020
Heliophysics	$651	$685	$698	$708	$722

MMS

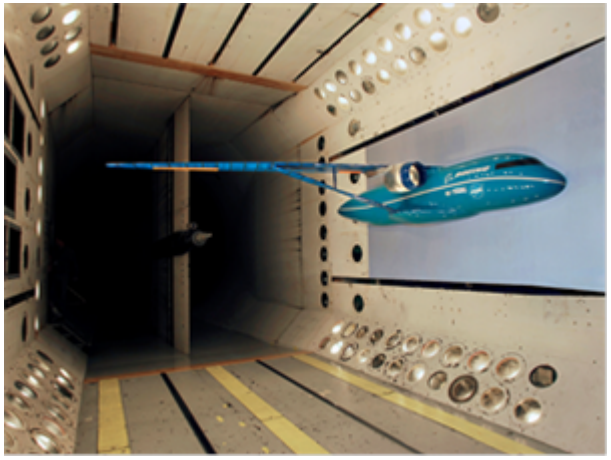
- Continues Solar Orbiter Collaboration (SOC) partnership with ESA, with plans to launch SOC in 2018.
- Continues development of ICON (2017 launch) and Solar Probe Plus (SPP) (2018 launch).
- Formulates GOLD, a recent Explorer selection.
- Supports the DRIVE initiative, the highest priority of the 2013 Decadal Survey.
- Operates over 18 Heliophysics missions (30 individual spacecraft), and maintains the research program.

Aeronautics

Outyears are notional

($M)	2016	2017	2018	2019	2020
Aeronautics	$571	$580	$588	$597	$606

- Aeronautics research contributes to the nation's economic growth and job creation through pioneering transformative capabilities that enable U.S. aviation industry to maintain and advance its global leadership.
- Continues to enable the implementation of NextGen with development and transfer of revolutionary air traffic management tools that will increase the efficiency of national air transportation system while ensuring the safety level.
- Develops new concepts and technologies for air vehicles that will drastically improve efficiency while minimizing environmental impact.
- Advances technologies that will enable routine access and safe operation of UAS in the NAS.
- Increases research investments in exciting and emerging areas in autonomous systems such as small UAS operation at low altitude, low carbon propulsion such as hybrid electric power and propulsion, and system-wide safety assurance.
- Funds convergent research to generate breakthrough new ideas integrating traditional and non-traditional aeronautics technological advancements.



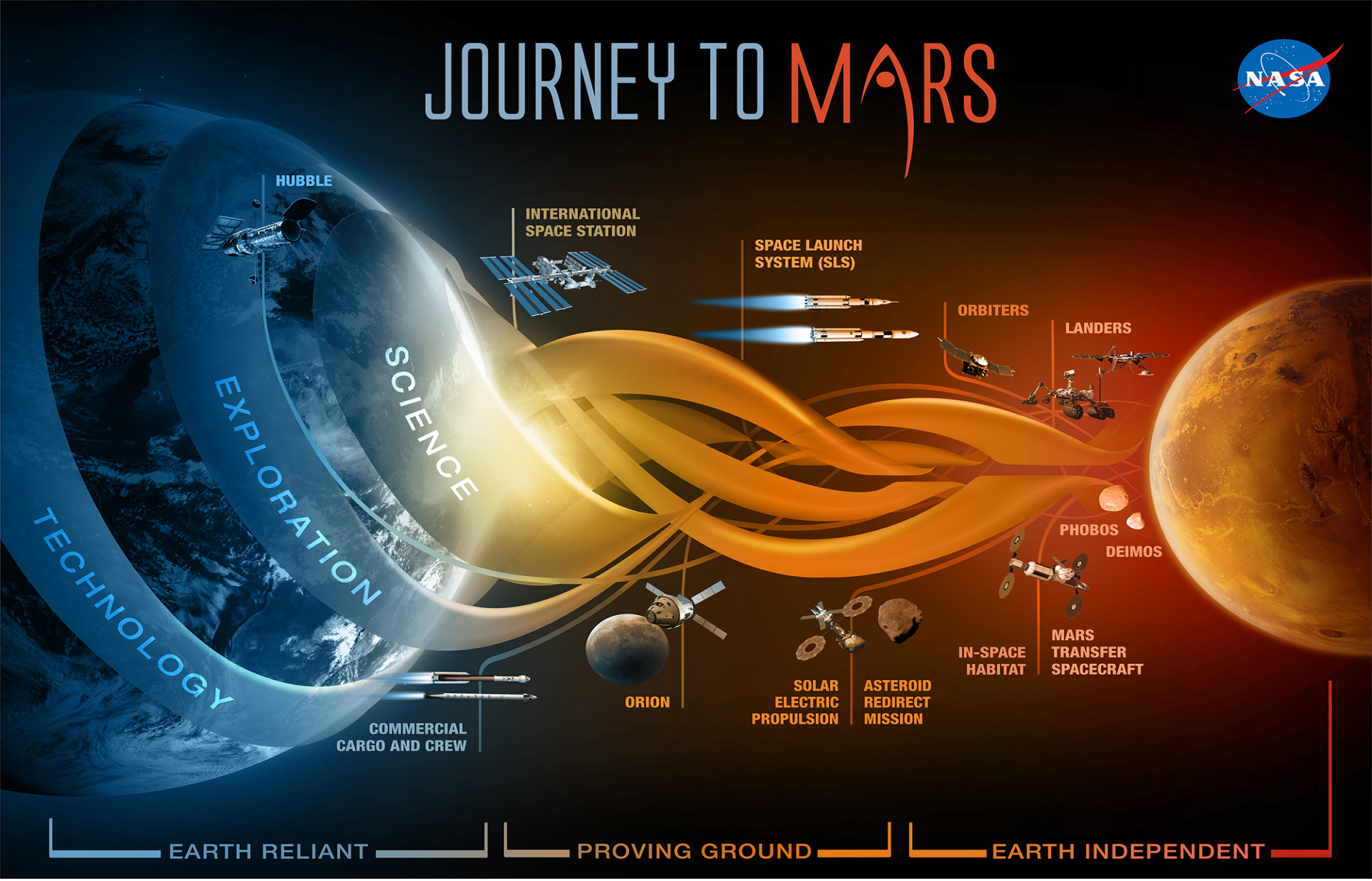
Space Technology

Outyears are notional

($M)	2016	2017	2018	2019	2020
Space Technology	$725	$736	$747	$758	$769

- Conducts **six in-space demonstrations** of crosscutting technologies: deep space atomic clock, a green propellant alternative to hydrazine, and four small spacecraft.
- Develops a high-powered **solar electric propulsion** capability to meet demands by U.S. aerospace industry, and for future NASA exploration missions.
- Continues progress toward a 2019 demonstration of **space-to-ground laser communications**.
- **Improves US aerospace industry capabilities** by validating large-scale composite structures for aerospace applications such as SLS.

- **Enables deep-space exploration** by advancing life-support, thermal management, and thermal protection systems for spacecraft such as Orion.
- **Supports U.S. research and development** with investments in small businesses to spark new ideas for the benefit of NASA, US aerospace and high tech industries; and engages academia through early-stage research, and solicit the U.S. aerospace community for technologies at the “tipping point.”
- Development of foundational technologies to **support future outer planets missions.**
- 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.



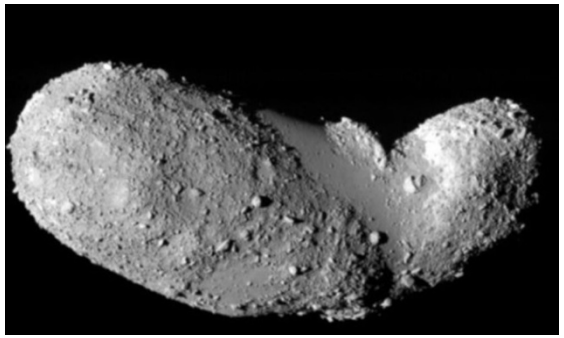
Providing the necessary resources to advance the Nation's space exploration plan and ensure that the United States remains the world's leader in space exploration and scientific discovery.

Asteroid Initiative Overview

NASA's Asteroid Initiative will enable enhanced capabilities for detecting Near-Earth Objects and a human rendezvous with an asteroid in the mid-2020's that prepares for human missions to Mars. NASA is committed to pursuing the Asteroid Redirect Mission in an affordable and feasible manner. The initiative will leverage and align existing activities:

- Asteroid observing efforts to identify and characterize asteroids (in Science);
- Demonstration of high power long life solar electric propulsion (in Space Technology);
- Development of SLS rocket and Orion crew vehicle for human space flight beyond low Earth orbit (in Exploration Systems); and
- Development of new capabilities for exploration in deep space (in ISS and Exploration R&D).

The Budget supports formulation of the asteroid mission, including advancing solar electric propulsion and capture systems.

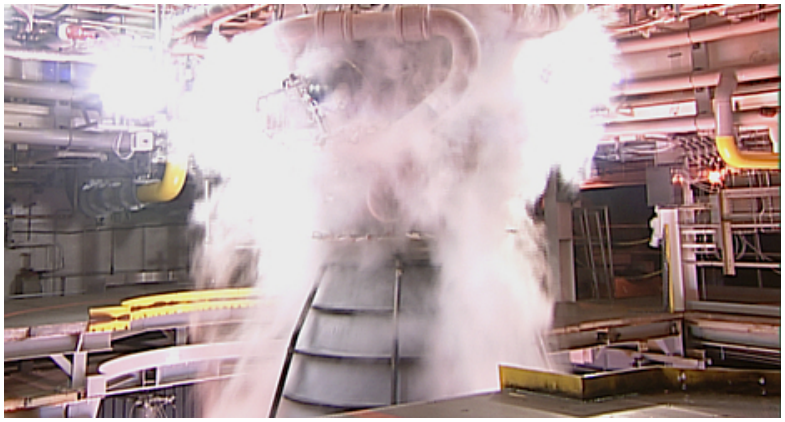


Exploration Systems Development

Outyears are notional

($M)	2016	2017	2018	2019	2020
ESD	$2,863	2,896	2,972	3,096	3,127

- Provides necessary funding for SLS, Orion and associated Exploration Ground Systems (EGS).
- Focuses on preparing for the first Exploration Mission (EM-1), the first pairing of Orion and SLS.
- Increases the manufacturing of components for Orion and SLS in preparation for 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.
- Continues modifications to the Kennedy Space Center's Launch Complex 39-B, Vehicle Assembly building and Launch Control Center.



Commercial Spaceflight

Outyears are notional

($M)	2016	2017	2018	2019	2020
Commercial Spaceflight	$1,244	$1,185	$732	$173	$1

- 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.
- Assures U.S. access to the ISS, bolsters American leadership, and reduces our dependence on Russian spaceflight capabilities for crew transportation.
- Builds on successes of the commercial cargo capabilities, the Commercial Crew Development (CCDev) activities, and Commercial Crew integrated Capability (CCiCap) activities.
- Ensures contracted services meet the Agency's crew transportation system certification requirements.

Exploration Research and Development

Outyears are notional

($M)	2016	2017	2018	2019	2020
Exploration R&D	$399	$402	595	$995	$1,077

- Includes the Human Research Program (HRP) and the Advanced Exploration Systems (AES) activities.
  - HRP researches the human system to provide countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human spaceflight missions.
  - AES pioneers new approaches for rapidly developing prototype systems, demonstrates key capabilities, and validates operational concepts for future human missions beyond Earth orbit.
  - AES maintains critical competencies at the NASA centers and is seeking to increase the use of that expertise in public-private partnership. AES also partners with the Science Mission Directorate and Space Technology Mission Directorate on robotic missions and technologies that meet science and exploration objectives.
- HRP will conduct an identical twin study based on the one-year crew increment (March 2015-March 2016) which will allow scientists to gain insight into the real-time genetic effects of space flight and its impacts on the human body at the molecular level.

International Space Station

Outyears are notional

($M)	2016	2017	2018	2019	2020
ISS	$3,106	$3,274	$3,641	$3,826	$4,039

- As the world's only crewed space-based multinational research laboratory and technology test bed, ISS is critical to the future of human exploration and to learning how to live and work in space.
- Enables:
  - Scientists to identify and quantify risks, develop countermeasures, and develop & test technologies that protect astronauts during extended human space missions.
  - Competitively selected unique research and development opportunities in the areas of biological and physical processes.
  - Use of ISS as a platform for current and future Earth and Space Science observing instruments.
  - Commercial demand driven market in LEO (transportation and commercial research uses)

- Maintains the ISS international partnership & sustains NASA's success in transitioning the ISS cargo supply function to American private industry.
- Supports development of in-space robotic servicing technology and capabilities.

Space and Flight Support

Outyears are notional

($M)	2016	2017	2018	2019	2020
SFS	$898	$917	$864	$845	$826

- Continues providing mission critical space communications and navigation services to customer missions, including human, science, and commercial crew and cargo missions.
- Continues the replenishment of Tracking Data Relay Satellite (TDRS) fleet and modernization of the aging Space Network via the Space Network Ground Segment Sustainment project.
- Supports the readiness and health of the crew for all NASA human space flight endeavors.
- Provides safe, reliable, and cost-effective launch services for three NASA payloads in FY 2016 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 US rocket testing requirements.

Education

Outyears are notional

($M)	2016	2017	2018	2019	2020
Education	$89	$90	$92	$93	$94

- Continues to align education efforts within the Agency to the Administration's Five-year Federal Strategic Plan on STEM Education.

- Supports the Office of Education efforts through evidence-based competitive processes to ensure the best use of NASA assets to meet the Nation's education goals. Collaborates with other agencies in areas of STEM education where the Federal government can have maximum impact.

- Continues the Agency's investment in the Space Grant, EPSCoR, and MUREP. Also maintains a focus on Minority Serving Institutions and community colleges, which generally serve a high proportion of minority students and prepare them for entry into the STEM workforce and for study at a four-year institution.

Safety, Security, and Mission Services and Construction

Outyears are notional

($M)	2016	2017	2018	2019	2020
SS&MS	$2,843	$2,886	$2,929	$2,973	$3,018
Construction & ECR	$465	$436	$443	$449	$456

- Safety, Security, and Mission Services
  - Funds ongoing operations of NASA Centers and major component facilities to ensure a safe, healthy, and environmentally responsible workplace.
  - Provides independent technical and safety oversight of NASA missions and operations.
  - Establishes Agency-wide requirements and capabilities that improve collaboration, efficiency, and effectiveness.
  - Ensures core services are ready and available for performing mission roles and responsibilities.

- Construction and Environmental Compliance and Restoration
  - Funds repair, revitalization, demolition, and recapitalization projects that reduce the Agency's footprint and provide efficient, modernized facilities.
  - Constructs new or modified facilities to conduct NASA's program missions.
  - Manages NASA's environmental clean-up responsibilities.

NASA

Strategic Plan

OUR MISSION
Drive advances in science, technology, aeronautics, and space exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth

Expand the frontiers of knowledge, capability, and opportunity in space

Advance understanding of Earth and develop technologies to improve the quality of life on our home planet

Serve the American public and accomplish our Mission by effectively managing our people, technical capabilities, and infrastructure

Acronyms

- AES: Advanced Exploration Systems
- CCDev: Commercial Crew Development
- CCP: Commercial Crew Program
- CRS: Cargo Resupply Services
- CYGNSS: Cyclone Global Navigation Satellite System
- DSCOVR: Deep Space Climate Observatory
- ECR: Environmental Compliance and Restoration
- EGS: Exploration Ground Systems
- EFT: Exploration Flight Test
- ELV: Expendable Launch Vehicle
- EM: Exploration Mission
- EPSCoR: Experimental Program to Stimulate Competitive Research
- ESA: European Space Agency
- ESD: Exploration Systems Development
- EVA: Extravehicular Activity
- EVI: Earth Venture Instrument
- EVS: Earth Venture Sub-Orbital solicitation
- FTE: Full Time Equivalent
- GLOBE: Global Learning and Observations to Benefit the Environment
- GOES: Geostationary Operational Environmental Satellite
- GOLD: Global Scale Observations of the Limb and Disk
- GPM: Global Precipitation Mission
- GRACE: Gravity Recovery and Climate Experiment
- HRP: Human Research Program
- ICESat: Ice Cloud and Land Elevation Satellite
- ICON: Ionospheric Connection Explorer
- IRIS: Interface Region Imaging Spectrograph
- ISS: International Space Station
- JASD: Joint Agency Satellite Division
- JPSS: Joint Polar Satellite System
- JWST: James Webb Space Telescope
- JUNO: Jupiter Uranus Neptune Outreach
- LADEE: Lunar Atmosphere Dust Environment Explorer
- LDCM: Landsat Data Continuity Mission
- LWS: Living With a Star
- LSP: Launch Services Program
- MAVEN: Mars Atmosphere and Volatile Evolution
- MMS: Magnetospheric Multiscale Mission
- MoO: Missions-of-Opportunity
- MSL: Mars Science Laboratory
- MPCV: Multi-Purpose Crew Vehicle
- MUREP: Minority University research and Education Program
- NOAA: National Oceanographic and Atmospheric Administration
- NICER: Neutron Star Interior Composition Explorer
- NPP: NPOESS Preparatory Project
- OCO: Orbiting Carbon Observatory
- OSIRIS-Rex: Origins Spectral Interpretation Resource Identification Security Regolith Explorer
- POES: Polar Operational Environmental Satellite
- R&D: Research & Development
- SAGE: Stratospheric Aerosol and Gas Experiment
- SET: Space Environment Testbeds
- SFS: Space and Flight Support
- SLS: Space Launch System
- SMAP: Soil Moisture Active-Passive Mission
- SOFIA: Stratospheric Observatory for Infrared Astronomy
- ST: Space Technology
- STEM: Science, Technology, Engineering and Mathematics
- SWOT: Surface Water and Ocean Topography
- TCTE: Total Solar Irradiance Calibration Transfer Experiment
- TDRS: Tracking and Data Relay Satellite
- TEMPO: Tropospheric Emissions Monitoring of Pollution
- TESS: Transiting Exoplanet Survey satellite
- WFIRST: Wide Field Infra Red Survey telescope (AFTA: Astrophysics Focused Telescope Assets)