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Statement of

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Subcommittee on Commerce, Justice, Science, and Related Agencies
Committee on Appropriations
U.S. House of Representatives

Mr. Chairman and Members of the Subcommittee, I am pleased to have this opportunity to discuss NASA's FY 2018 budget request. As the Agency approaches its 60th anniversary in 2018, the requested budget will maintain NASA's place as the global leader in space. We appreciate the Subcommittee's support, and have been heartened by the frequently expressed bipartisan commitment to constancy of purpose for NASA, particularly as NASA's goals extend over decades. Beyond these expressions of support, the NASA Transition Authorization Act of 2017 and the FY 2017 Consolidated Appropriations Act represent concrete contributions to that continuity, and we appreciate the Subcommittee's hard work on NASA's behalf. The FY 2018 budget request of $19.1 billion reflects the continuity of mission that is vital to our continued success.

NASA's historic and enduring purpose can be summarized in three major strategic thrusts: Discover, Explore, and Develop. These correspond to our missions of scientific discovery, missions of exploration, and missions of new technology development in aeronautics and space systems. NASA is focused on these missions, but we never lose sight of the other contributions that our unique achievements make possible. NASA missions inspire the next generation, inject innovation into the national economy, provide critical information needed to address national challenges, and support global engagement and international leadership. As the President has said, American footprints on distant worlds are not too big a dream. NASA is executing programs, step by step, to make this dream, and the broader quest to explore and understand the universe, a reality.

The missions that deliver these benefits are on track for some significant milestones in the coming years. The Parker Solar Probe, Transiting Exoplanet Survey Satellite (TESS), and the James Webb Space Telescope are on track to launch in 2018, and a new Mars rover is on pace for a 2020 launch. The first of a new series of experimental aircraft (X-planes) will fly in 2021 to begin investigating low boom supersonic flight. Working with commercial partners, NASA will fly astronauts on the first new crew transportation systems in a generation from American soil in 2018. We are continuing the development of solar electric propulsion for use on future human and robotic missions. NASA is fabricating and assembling the systems to launch humans into lunar orbit not later than 2023, as NASA works to open the space frontier. NASA's FY 2018 request supports progress toward these major milestones as part of the diverse portfolio of work the Agency executes as we explore, discover, and develop on behalf of the American people.

Science

NASA uses the vantage point of space to achieve – with the science community and our domestic and international partners – a deep scientific understanding of our home planet, the Sun and its effects on the solar system, other planets and solar system bodies, our galactic neighborhood, and the universe beyond. We focus our research on three overall, interdisciplinary objectives: 1) Safeguarding and improving life on Earth, 2) Searching for life elsewhere, and 3) Expanding our knowledge through research from here at home into the deep universe. NASA's FY 2018 budget requests $5,712 million for NASA's Science program, including $1,754 million for Earth Science, $1,930 million for Planetary Science, $817 million for Astrophysics, $534 million for the James Webb Space Telescope, and $678 million for Heliophysics.

This budget includes a new Science-Mission-Directorate-wide initiative to use small, less expensive satellites to advance selected high-priority science objectives in a cost-effective manner. This initiative will implement recommendations from the National Academy of Sciences, which concluded that, due to recent technological progress, these small satellites are suitable to address such science goals. All four science themes, to a varying degree, will focus technology development on CubeSats/SmallSats and targeted science missions to exploit this value. The initiative will also provide partnership opportunities between commercial partners, international counterparts, and NASA and further leverage and align with investments made within NASA.

NASA has a unique capability to develop and launch satellite missions to study Earth from space. In addition to designing and flying its own science missions, NASA develops weather satellites for NOAA and Landsat satellites for USGS. NASA Earth Science uses its 20 coordinated spaceborne missions, as well as suborbital and airborne platforms, to understand the Earth as an integrated system. Environmental data products derived from these observations are used in a range of real-world applications, including weather forecasts, agricultural production, water management, disease early warning, environmental trends, sea-level change and guiding responses to natural disasters. NASA's budget request of $1.8 billion enables a strong, stable program that continues these essential functions, and allows NASA to maintain its many public-private and international partnerships.

In the past year, NASA has successfully launched innovative satellites and spaceborne instruments, including the Cyclone Global Navigation Satellite System (CYGNSS) small-satellite constellation, two new instruments on the International Space Station (ISS), and several CubeSats. CYGNSS, a constellation of eight small satellites, was launched on December 15, 2016. Using reflected Global Positioning System (GPS) signals from the ocean surface, these satellites make first-ever, frequent measurements of winds and air-sea interactions in evolving hurricanes and tropical storms, providing insight into how these storms rapidly intensify. CYGNSS science data will be available for use and evaluation during the 2017 Atlantic hurricane season.

Looking forward, the FY 2018 request advances the Decadal Survey recommendation to ensure an ongoing vital fleet of research satellites to support science and applications. Recent highlights include the completion, launch, and initial operations of the Gravity Recovery and Climate Experiment Follow-on (GRACE-FO) mission. GRACE-FO will continue to track water across the planet and provide measurements used operationally in national drought monitoring products. Launch of GRACE-FO will occur in late 2017 or early 2018. Also in development, and on track for launch in the fourth quarter of calendar year 2018, is the Ice, Cloud, and land Elevation Satellite-2 (ICESat-2), which will measure ice sheet topography, sea ice thickness, cloud and aerosol heights, and vegetation canopy heights.

Landsat missions have provided the longest continuous, consistently processed set of global satellite measurements of the Earth – in 2018 this record will extend to 46 years. This budget request includes full funding for Landsat 9, a near-copy of Landsat 8, which is on track and targeted for launch in 2021.

Landsat 9, a collaboration between NASA and the USGS, is part of the overall Sustainable Land Imaging (SLI) architecture that will provide continuous, global land imaging through 2035. These and other new missions, combined with those now in orbit, will allow NASA to maintain a robust Earth Science program moving forward.

The request includes a reduction of $167 million from the FY 2017 Consolidated Appropriations level for Earth Science. These savings are accomplished by cancelling three missions in development as well as eliminating support for low-priority NASA instruments on NOAA's Deep Space Climate Observatory (DSCOVR) mission and reducing funding for Earth Science research grants. The reduction re-balances NASA's Science portfolio while minimizing impacts to operating Earth Science missions, and focuses on priorities of the science and applications communities.

With this year's budget request of $1.9 billion for Planetary Science, NASA continues to explore our solar system to help answer fundamental questions about our home and destiny in the universe, and to explore whether there is life beyond Earth. Planetary Science missions are exploring and operating throughout the solar system. Missions such as the Lunar Reconnaissance Orbiter at our Moon, as well as the rovers and orbiters at Mars, are informing us about our closest neighbors. Adding to our missions at Mars, the InSight (Interior Exploration using Seismic Investigations, Geodesy and Heat Transport) lander will be launched in May 2018 to land on the surface in November. InSight is designed as a seismic and heat flow subsurface probe that will study the interior structure of Mars along with understanding its present-day level of global activity.

Further out in the solar system, NASA's Juno spacecraft achieved a first-ever polar orbit at Jupiter last July, and has already shown that Jupiter's magnetic fields are different and possibly more complicated than originally thought. NASA's New Horizons mission completed a successful flyby of Pluto and is more than halfway to its next target, the Kuiper Belt Object 2014 MU69. Meanwhile, the OSIRIS-REx (Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer) mission conducted a search for elusive objects known as Earth-Trojan asteroids while on its journey to the asteroid Bennu, arriving in August 2018.

After 13 years orbiting Saturn, our Cassini spacecraft has begun a series of 22 daring dives through the 1,500-mile-wide gap between the planet and its rings as part of the mission's "Grand Finale" end-of-mission maneuvers. When Cassini makes its final plunge into Saturn's atmosphere on September 15, it will send data from several instruments – most notably, data on the atmosphere's composition – until the very end of this highly successful mission.

With support from the FY 2018 budget request, NASA is continuing to develop our new Mars 2020 rover and Europa Clipper mission which will further the search for life beyond Earth. In January 2017, NASA selected two new Discovery missions, named Lucy and Psyche; these missions will expand our knowledge of asteroids and small bodies within the solar system.

NASA's Astrophysics program continues to operate the Hubble, Chandra, Spitzer, Fermi, Kepler, and Swift space telescopes, and the Stratospheric Observatory for Infrared Astronomy (SOFIA) airborne observatory, missions that together comprise an unrivaled resource for the study of our universe. NASA's next major Astrophysics mission, the James Webb Space Telescope (Webb), continues on schedule for its October 2018 launch and remains within budget. Webb will be a giant leap forward in our quest to understand the universe and our origins. The telescope will examine every phase of cosmic history: from the first luminous glows after the Big Bang to the formation of galaxies, stars, and planets, to the evolution of our own solar system. During FY 2017, the combined Webb telescope and instrument unit will be tested at the Johnson Space Center, and with the FY 2018 request, NASA will integrate this combination onto the spacecraft and prepare it for launch.

NASA will also complete the Transiting Exoplanet Survey Satellite (TESS) for launch in 2018. TESS will extend the pioneering exoplanet discoveries of the Kepler Space Telescope by looking for rocky exoplanets orbiting the nearest and brightest stars in the sky in time for Webb to conduct follow-up observations to search for markers of potential habitability. During FY 2018, NASA will continue formulation of the Wide-Field Infrared Survey Telescope (WFIRST). NASA's next Astrophysics Small Explorer, the Imaging X-Ray Polarimetry Explorer (IXPE), will continue development in FY 2018 for an expected launch in 2021.

NASA's Heliophysics program operates 18 active missions comprising 28 spacecraft, called the Heliophysics System Observatory (HSO), to understand the Sun and its interactions with Earth, the solar system and the interstellar medium, including space weather. NASA continues to gain important insight from the HSO, including new observations from the Magnetospheric Multiscale (MMS) Mission, which recently celebrated its second year in space this March. Later this year, NASA is looking forward to the launch of its Ionospheric Connection (ICON) mission, which will investigate the roles of solar forces and Earth's weather systems that drive extreme and unpredicted variability in the ionosphere. The FY 2018 request supports the continued development of the Parker Solar Probe and the Global-scale Observations of the Limb and Disk (GOLD) missions, both planned for launch in 2018. The Parker Solar Probe will fly closer to the Sun than any previous mission to study its outer atmosphere. GOLD, to be hosted on a commercial communications satellite, will measure densities and temperatures in Earth's thermosphere and ionosphere to improve our understanding and predictive capabilities for activity in this region, which is of crucial importance for space weather. The request will also enable the continued development of the critical instruments for the NASA-European Space Agency (ESA) Solar Orbiter Collaboration mission. Finally, NASA is continuing to implement the scientific community's priorities, identified in the latest Decadal Survey, including the recently announced Interstellar Mapping and Acceleration Probe (IMAP) opportunity as part of the Solar Terrestrial Probes Program.

By funding fundamental basic and targeted research opportunities, NASA will continue to develop and improve predictive models through enhanced understanding of the science of space weather. NASA, in coordination with other national and international agencies, will further the transition of research models to operations and seek to improve models already in operation through collaboration with operators, model developers, and researchers. Better understanding of space weather could help protect our technological infrastructure on Earth, including the Nation's electrical grid.

Aeronautics

NASA's Aeronautics Research program advances U.S. global leadership by developing and transferring key enabling technologies to make aviation safer, more efficient, and more environmentally friendly. With a request of $624 million for Aeronautics, the FY 2018 budget takes the next significant step in the New Aviation Horizons initiative – a bold series of X-planes – and systems demonstrations to support the goals of enabling revolutionary aircraft and improving the efficiency of the national air transportation system. With the FY 2018 request, NASA will demonstrate and validate transformative concepts and technologies as integrated systems in flight to meet the most challenging needs of aviation. Specifically, in FY 2018, NASA will award a contract for detailed aircraft design, build, and validation of the first X-plane, a Low Boom Flight Demonstrator (LBFD) that will demonstrate quiet overland supersonic flight and open a new market to U.S. industry. The LBFD X-plane is expected to achieve first flight by FY 2021, initially focused on flights to ensure safe operations and then proceeding to its sonic boom noise testing flight campaign. NASA has laid the groundwork for this initiative through years of research at the component level, through computer modeling, and with ground tests, and will now move on to critical flight tests. NASA is also laying the groundwork through tests and studies for a second X-plane, a subsonic flight demonstrator notionally scheduled for a first flight in FY 2026 that will show

revolutionary improvements to fuel efficiency and airport noise to reinforce U.S. technological leadership in the next generation of commercial aircraft.

NASA's request for Aeronautics will ensure investment in developing revolutionary tools and technologies ranging from hybrid and all-electric aircraft, autonomy, advanced composite materials and structures, data mining, verification and validation of complex systems, and revolutionary vertical lift vehicles, to enabling further advances for transformative vehicle and propulsion concepts that will address a broad array of our aviation industry's needs. NASA will continue to cultivate multi-disciplinary, revolutionary concepts to enable aviation transformation and harness convergence in aeronautics and non-aeronautics technologies to create new opportunities in aviation. In partnership with industry, NASA will explore technology advancements such as advanced lightweight aircraft structures to enable higher performing, more efficient subsonic aircraft configurations.

NASA will conduct flight demonstrations in a new configuration of the X-57 Maxwell, a general aviation-scale aircraft that will test highly integrated distributed electric propulsion technology. These tests represent a crucial step in the flight test process as conventional-fuel engines will be replaced with electric motors and electrical storage and power distribution systems, providing real-world data on all-electric flight. NASA will continue to advance the state of the art in hypersonic flight through technology demonstrations and computational and design tool development in partnership with other Federal agencies, leveraging flight test data to support NASA's research while simultaneously reducing risk and enhancing the effectiveness of other agencies' programs. NASA's efforts are aimed at reducing the uncertainty in computational models and ground testing, as well as flight testing operations. Overcoming these barriers will enable more effective technology risk tools, allowing for a better understanding of the true potential of future hypersonics technologies.

NASA continues to advance research and development into the air traffic management system to realize the Federal Aviation Administration's (FAA's) full vision for the Next Generation Air Transportation System (NextGen). NASA has recently begun a series of major flight tests to demonstrate significantly more efficient arrival and departure operations in full partnership with FAA and industry. Moving key concepts and technologies from the laboratory into the field through demonstrations ultimately will benefit the public by increasing capacity and reducing the total cost of air transportation. NASA will develop and demonstrate innovative solutions that enable use of new vehicle technologies through proactive mitigation of risks in accordance with target levels of safety, and provide analyses and safety assessments supporting use of analytical models in the specification, design, and analysis of complex, safety-critical aviation systems. NASA will also continue to lead the world for enabling safe Unmanned Aircraft Systems (UAS) operations by demonstrating key technologies that will integrate UAS operations in the National Air Space, as well as realize safe, low-altitude operations of small UAS through development of the UAS Traffic Management concept, or UTM.

Across all of these research areas, NASA investments will nurture U.S. university leadership in innovation that will foster and train the future workforce, and leverage non-aerospace technology advancements. Specifically, NASA will execute the first competitive University Leadership Initiative awards under the University Innovation Challenge project. These awards will sponsor research by university leaders who have independently analyzed the technical barriers inherent in achieving the Aeronautics Research Mission Directorate strategic outcomes, and who have proposed multi-disciplinary technical challenges along with supporting activities to address those barriers.

Space Technology

NASA's FY 2018 request includes $679 million for Space Technology to conduct rapid development and incorporation of transformative space technologies that will create opportunities for the U.S. aerospace

industry, enable NASA's future missions, and increase the capabilities of other U.S. agencies. NASA's Space Technology program has developed a diverse portfolio creating a technology pipeline to solve the most difficult challenges in space.

Technology drives exploration by continuing the maturation of enabling technologies for future human and robotic exploration missions, including deep space optical communications to return more data and improve operations, high power solar electric propulsion technologies for highly efficient in-space transit, high performance spaceflight computing, autonomous and hazard avoidance landing, extreme environment solar power, and advanced materials to improve rover mobility performance at low temperatures.

NASA will continue to prioritize "tipping point" technologies and early-stage innovation with more than 600 awards to industry and small businesses, private innovators, and academia to spark new ideas to support the broader U.S. aerospace and high tech sectors as well as for the benefit of NASA. As we complete these efforts, appropriate technologies will be transferred and commercialized to benefit a wide range of users, ensuring that our Nation realizes the full economic value and societal benefit of these innovations. Space Technology's partnerships engage more than 380 companies and continue to be a major priority in 2018.

The Green Propellant Infusion Mission spacecraft and the Deep Space Atomic Clock instrument will both be delivered to orbit as part of the U.S. Air Force Space Technology Program-2 mission aboard a SpaceX Falcon 9 Heavy booster slated for late 2017. The Green Propellant Infusion Mission will demonstrate a propulsion system using a propellant that is less toxic and has approximately 40 percent higher performance by volume than hydrazine, and which will reduce spacecraft processing costs. The Deep Space Atomic Clock demonstrates navigational accuracy improvements (with 50 times more accuracy than today's best navigation clocks) for deep space and improved gravity science measurements.

With the FY 2018 request, the Restore-L satellite servicing project will be restructured to reduce its cost and support a nascent commercial satellite servicing industry. This project will continue the development of key technologies, including rendezvous and proximity operations sensors, propellant transfer systems, and other robotic tools that will enhance and enable future NASA science and exploration missions. NASA is also pursuing a potential collaboration with the Defense Advanced Research Projects Agency and industry to most effectively advance satellite servicing technologies and ensure broad commercial application. NASA is continuing the Robotic Refueling Mission 3 that will focus specifically on servicing cryogenic fluid and xenon gas interfaces, which will support future scientific missions as humans extend their exploration farther into our solar system. Building on the Robotic Refueling Mission technology demonstrations on ISS, Space Technology will advance servicing technologies and partner with domestic private enterprise to commercialize the results, establishing a new U.S. industry.

NASA continues development of high-powered solar electric propulsion. This technology is scalable, widely applicable to human and robotic missions, and is a critical component of NASA's future exploration plans. In FY 2018, NASA plans to complete ground testing of the Solar Electric Propulsion engineering development units for magnetically-shielded Hall effect thrusters. We will begin fabrication of spaceflight-qualified hardware scheduled for delivery in 2019.

Upon completion of hardware build, the Laser Communications Relay Demonstration project will start integration and test to support a FY 2019 Launch Readiness Date. The Mars Oxygen In-Situ Resource Utilization Experiment and Terrain Relative Navigation projects will complete hardware development, and will enter into integration and test to support the Mars 2020 schedule. In addition, the Mars Environmental Dynamics Analyzer and Mars Entry, Descent, and Landing Instrument 2 will successfully

complete technology development, and be delivered for Mars system integration and test on the Mars 2020 robotic lander mission.

NASA will also complete testing of a 1kW fission reactor that could aid in a potential future design of a 10kW-class system. Fission reactor systems have the potential to provide abundant energy for surface exploration. Full ground testing at design temperatures is planned for early FY 2018 at the Nevada Nuclear Security Site.

Human Exploration and Operations

The FY 2018 request includes $3,934 million for Exploration, with $3,584 million for Exploration Systems Development, and $350 million for Exploration Research and Development. The FY 2018 request also includes $4,741 million for Space Operations, including $1,491 million for the International Space Station (ISS), $835 million for Space and Flight Support, and $2,415 million for Space Transportation – both commercial crew system development and ongoing crew and cargo transportation services that resupply the ISS. The request provides the necessary resources in FY 2018 to support development as planned of the SLS rocket and Orion crew capsule, as well as on the technologies and research needed to support a robust exploration program. The budget creates new opportunities for collaboration with industry on ISS and supports public-private partnerships for exploration systems that will extend human presence into the solar system.

The ISS is the first step on the road to deep space exploration, a nearby outpost in space where humanity has taken its early steps on its journey into the solar system. This unique microgravity laboratory is delivering the knowledge and technology we need to keep our astronauts safe, healthy, and productive on deep space missions of increasing durations. This knowledge and technology are the cornerstones of our exploration strategy. Research on the ISS has advanced the fundamental biological and physical sciences for the benefit of humanity, improving life on Earth, and adding to our understanding of the universe. The ISS forms the foundation of the Nation's global leadership in space exploration through the ISS International Partnership of five space agencies representing 15 nations.

Under the original Commercial Resupply Services (CRS) contracts, our two commercial cargo partners, Space Exploration Technologies (SpaceX) and Orbital ATK, are providing cargo deliveries to the ISS. Using the space launch vehicles developed in partnership with NASA, SpaceX and Orbital ATK have also helped to bring some of the commercial satellite launch market back to the U.S. and have reduced commercial launch costs. Under new CRS-2 contracts, SpaceX, Orbital ATK, and Sierra Nevada Corporation will deliver critical science, research, and technology demonstrations to the ISS over five years from 2019 through 2024. Working with our commercial crew partners, SpaceX and the Boeing Company, NASA plans to return crew launch capability to American soil in 2018. The FY 2018 request provides critical resources in this exciting and challenging period as we work with our partners to launch the first new U.S. human spaceflight capability in a generation.

Under the auspices of the ISS National Laboratory, managed by the Center for the Advancement of Science In Space (CASIS), NASA and CASIS continue to expand research on the ISS sponsored by pharmaceutical, technology, consumer product, and other industries, as well as by other Government agencies, such as the National Institutes of Health and the National Science Foundation. Through CASIS' efforts, the ISS National Lab has reached full capacity for allocated crew time and upmass and downmass, and is expected to continue at this level of activity for the foreseeable future.

NASA's activities in low Earth orbit (LEO), including research aboard ISS and the use of commercial crew and cargo transportation services, are encouraging the broader commercial development of LEO. The ISS serves as the focal point for NASA's LEO commercialization development efforts by enabling

private industry to foster new markets – such as space tourism or satellite servicing – by developing and maturing their own capabilities and services for Government and non-Government customers. These new markets could also support platforms on which NASA would be only one of many Government and non-Government customers.

As we move out beyond LEO, we will employ new deep space systems, including the heavy-lift Space Launch System (SLS), Orion crew vehicle, the Exploration Ground Systems (EGS) that support them, and new deep space habitation capabilities to be developed through public-private partnerships and international partnerships.

NASA plans to launch an initial, uncrewed deep-space mission, Exploration Mission-1 (EM-1), in 2019. The mission will combine the new heavy-lift SLS with an uncrewed version of the Orion spacecraft on a mission to lunar orbit. A crewed mission, EM-2, will follow not later than 2023; the FY 2018 budget fully funds the Agency baseline commitment schedule for EM-2 and the Orion spacecraft. Missions launched on the SLS in the 2020s will establish the capability to operate safely and productively in deep space.

SLS, Orion, and EGS are the critical capabilities for maintaining and extending U.S. human spaceflight leadership beyond LEO to the Moon, Mars, and beyond. For SLS, the nationwide NASA and industry team has completed five years of detailed engineering design and is now in large-scale hardware production and testing for EM-1 and subsequent flights. Core Stage hardware is taking shape inside the 43 acres of factory floor space at the Michoud Assembly Facility (MAF) in Louisiana (where work continues despite a tornado which hit the facility this February), while SLS Boosters, Core Stage Engines, and other flight hardware are also in production and testing in Alabama, Utah, Mississippi, and facilities elsewhere across the country. For Orion, the EM-1 flight Crew Module is being welded and outfitted at the Kennedy Space Center (KSC), software development and testing continues in Colorado and Texas, and the European-provided Service Module structural article has successfully completed testing at Plum Brook Station in Ohio. At KSC, NASA has completed installation of all ten work platforms in the giant Vehicle Assembly Building (each weighing up to 380,000 pounds, aligned with pinpoint precision), outfitting continues on the 355-foot-tall Mobile Launcher, and historic Launch Pad 39B is being prepared with new flame trench bricks and support systems. These are the early steps on a journey that leads American astronauts into deep space, permanently.

The FY 2018 request also includes funding for exploration research and development that will make future missions safer, more reliable, and more affordable. Among these efforts, NASA is now working on the second phase of the Next Space Technologies for Exploration Partnerships (NextSTEP), an effort to stimulate deep-space capability development across the aerospace industry. Through these initial public-private partnerships, NextSTEP partners will provide advanced concept studies, technology development projects, and significant measurements in key areas, including habitat concepts, environmental control and life support systems, advanced in-space propulsion, and small spacecraft to conduct missions related to Strategic Knowledge Gaps. The NextSTEP efforts are a key component, along with international partnerships and NASA technology development, of our overall strategy to move into deep space, and NASA intends to perform integrated ground testing using habitation capabilities developed by the NextSTEP partners in 2018.

We will continue to investigate approaches for reducing the costs of exploration missions to enable a more expansive exploration program.

With the FY 2018 request, the Asteroid Redirect Mission (ARM) is no longer included in NASA's exploration plans, but key work done for the mission will be carried forward to support NASA's human exploration efforts, particularly in the area of solar electric propulsion. In-space power and propulsion

and deep space habitation are central to future human exploration. Development and deployment of these capabilities will be a focus of the early-to-mid 2020s, leading to crewed missions beyond the Earth-Moon system, including to the Mars system. More details on NASA's plans will be detailed in the exploration roadmap requested by the Congress in the NASA Transition Authorization Act of 2017.

The budget request provides for critical infrastructure indispensable to the Nation's access and use of space, including Space Communications and Navigation (SCaN), Launch Services Program (LSP), Rocket Propulsion Testing (RPT), and Human Space Flight Operations (HSFO).

Management and Efficiency

NASA's FY 2018 budget proposes the termination of the Office of Education (OE) and its portfolio of programs and projects. The Office of Education has experienced significant challenges in implementing a focused NASA-wide education strategy, including providing oversight and integration of Agency-wide education activities. The FY 2018 budget supports the orderly closeout and/or transition of these activities needed to comply with Federal laws and regulations regarding contracts, grants/cooperative agreements, civil servants, records management, and administrative infrastructure. While this budget no longer supports the formal OE programs, NASA will continue to inspire the next generation through its missions and the many ways that our work excites and encourages discovery by learners and educators. The Science Mission Directorate (SMD) Science, Technology, Engineering, and Mathematics (STEM) Science Activation program will continue to focus on delivering SMD content to learners of all ages through cooperative agreement awards. NASA does not intend to transfer ownership of programs formerly funded by OE to SMD, as these activities fall outside the scope and resources of the SMD STEM Science Activation program.

As is noted in the Government Accountability Office's (GAO) February, 2017 "High Risk Series" report, NASA efforts at improving program management and performance for major developments is yielding tangible results in the form of improved estimates, and better cost and schedule performance. As GAO notes: "in 2016, overall development cost growth for the portfolio of 12 development projects fell to 1.3 percent and launch delays averaged 4 months. Both of these measures are at or near the lowest levels we have reported since we began our annual assessments in 2009" (these measures exclude Webb, which was rebaselined in 2011).

NASA's Mission Support Directorate directly enables NASA's portfolio of missions in aeronautics, space technology, science, 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 achieve program objectives for all NASA missions. With installations in 14 states, NASA collectively manages $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.

NASA is transforming the management of information technology (IT) and improving cybersecurity by implementing the results of an internal IT Business Services Assessment (BSA) and working to improve compliance with the Federal Information Technology Acquisition Reform Act (FITARA) and the Federal Information Security Modernization Act (FISMA). Two of our key goals are to create a complete inventory of NASA's IT assets and better secure NASA's networks. The budget request includes an increase of $32 million in cybersecurity and IT management spending, which will be used to complete stronger Personal Identity Verification (PIV) compliance, mature Security Operation Center (SOC) capabilities, improve detection and response to malicious activities, and develop and deploy IT Portfolio Management tools and processes. The increase will support NASA's efforts to provide the appropriate

visibility and involvement of the Office of the Chief Information Officer in the management and oversight of IT resources across the Agency.

To maintain critical capabilities and successfully meet current and future mission needs, NASA will continue its implementation of an Agency Operating Model that involves a disciplined, multi-year effort that engages the participation of all nine NASA Centers, the Jet Propulsion Laboratory, and four Mission Directorates, as well as NASA senior management. The NASA Operating Model seeks to advance best-in-class capabilities by alignment to recognized Centers; to ensure that technical capabilities are matched to mission need; to enable mutual dependencies among NASA Centers, programs, and the leadership team to meet mission challenges; to build flexibility in NASA's institutional resources to support a modern, agile workplace; and to ensure that decision making considers the outcomes for the successful performance of the Agency as a whole.

Conclusion

The program of exploration and discovery we propose to execute with the FY 2018 request should be a source of pride to the Committee, the Congress, and the American people. With constancy of purpose and consistent support from the Congress, we look forward to extending human presence into deep space, exploring potentially habitable environments around the solar system, deepening our understanding of our home planet, pushing our observations of the universe back to the time when the first stars were forming, and opening the space frontier. While the future benefits of discovery are always difficult to predict, our past and present give us confidence that the resources we are requesting represent an investment that will return to the Nation multiplied many times.

Mr. Chairman, I would be pleased to respond to your questions and those of other Members of the Subcommittee.