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Statement of
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United States Senate

Mr. Chairman and Members of the Committee, thank you for the opportunity to testify on NASA's research and development efforts. Under the President's leadership, NASA and the Nation are embarking on an ambitious program of space exploration that builds on new technologies as well as proven capabilities as we expand humanity's reach into the solar system. While reaching for new heights in space, NASA is creating new jobs right here on Earth – especially for the next generation of American scientists and engineers – by supporting cutting edge aeronautics and space technology innovations, research and development that will help fuel the Nation's economy for years to come.

Despite tough economic times, the FY 2013 budget continues to implement the space science and exploration program agreed to by the President and a bipartisan majority in Congress, laying the foundation for remarkable discoveries here on Earth and in deep space, including new destinations such as an asteroid and Mars. We have made tough, but sustainable, choices to provide stability and continuity to existing priority programs and set the pace for opening the next great chapter in exploration.

On a personal note, I am honored to be at NASA serving as its Chief Technologist. As the NASA Administrator's top advisor on technology, I am responsible for guiding strategic Agency investments in technology; facilitating technology transfer, partnerships and commercialization activities across the Agency; advocating externally on behalf of NASA's R&D programs; demonstrating and communicating societal impacts of NASA technology investments; as well as, the management and budget of the Space Technology Program. I come from Cornell University, where I also served on the faculty in the School of Mechanical and Aerospace Engineering and teach in Cornell's Systems Engineering Program. My background in aerospace technology, with nearly 20 years in both industry and academia, will help me to ensure NASA's technology portfolio addresses the near-term, mission-driven and the long-range, transformative technologies required to meet our Nation's far-reaching exploration goals.

As requested, I am going to speak about NASA's prize programs and technology efforts and the activities of the Space Technology Program, in which I play a direct role, as well as technology activities throughout NASA in which I have an advisory role. Administrator Bolden will be discussing details of the FY 2013 Budget request for NASA in his testimony to this committee tomorrow.

NASA provides America with unique capabilities simply because of how we ask questions about our universe. By taking humans to inhospitable places we learn a little bit more about how Earth sustains us, because we have to recreate that environment for our astronauts to survive. NASA solves difficult technical problems and thereby inspires Americans to invent technologies that make life better right here on Earth.

As recognized by Congress in Section 201 of the America COMPETES Reauthorization Act of 2010 (P.L. 111-358), "a renewed emphasis on technology development would enhance current mission capabilities and enable future missions, while encouraging NASA, private industry, and academia to spur innovation." A focus on innovation and technology is essential, both to enable fresh approaches to NASA's current missions and to allow the Agency to pursue entirely new missions. NASA is fully engaged in support of the National Science and Technology Council and the Office of Science and Technology Policy to implement the crosscutting requirements of the Act. NASA has completed one of three NASA-specific reporting requirements and is on track to complete the remaining requirements in the June time frame.

Developing technological solutions stimulates the growth of the innovation economy. The safety, security, and convenience provided by weather and navigational spacecraft, efficiency improvements in both ground and air transportation, super computers, solar- and wind-generated energy, the cameras found in many of today's cell phones, improved biomedical applications including advanced medical imaging and even more nutritious infant formula, as well as the protective gear that keeps our military, firefighters and police safe, have all benefitted from our nation's investments in aerospace technology.

Those benefits are hard to quantify, but we know they are real. We see this with companies like GreenField Solar who developed PhotoVolt solar cells through cooperation with NASA's Glenn Research Center. When paired with StarGen solar concentrator which tracks and captures the sun's rays throughout the day, this system can concentrate sunlight up to 900 times its normal intensity. GreenField solar is now generating grid-scale solar power at a lower cost per kilowatt-hour than most existing photovoltaic systems. Bernard Sater, the GreenField Solar founder and former scientist at the NASA Glenn Research Center in Ohio, retired early from NASA in 1994 to develop this solar cell. He continued research in the lab at NASA Glenn, collaborating with experts through the development and testing phases of the process. The resulting technology has led to several Ohio demonstration projects, including the Rockefeller Park Greenhouse in Cleveland. U.S. job opportunities will increase as GreenField ramps up its commercialization efforts. NASA discoveries benefit every aspect of our lives. We see this in our smartphones, our cars, our airports, and even in my children's toothpaste. Thanks to this Administration and the Congress working together, the Agency will continue to ask the bold questions that lead to these technology benefits, or "spinoffs" as we call them at NASA.

Investments in space and aeronautics technology stimulate the economy and contribute to the Nation's global competitiveness through the creation of new products and services, new business and industries, and high quality, sustainable jobs. According to the 2011 Aerospace Industries Association Year End Review, the U.S. aerospace industry experienced its eighth consecutive year of growth and maintained the largest trade surplus of any manufacturing industry. A technology-driven NASA will maintain the Nation's aerospace community as a global technological leader for many years to come. NASA innovation also serves as an inspiration for young people to pursue science, technology, engineering, and mathematics (STEM) education and career paths.

Each NASA mission takes years of planning and development to ensure its success. And every NASA mission has been made possible by pushing the technology envelope. NASA established the Office of the Chief Technologist to re-energize NASA's technology development engine to ensure the advanced

technologies exist for NASA's future missions. The National Research Council (NRC) emphasized the importance of a stable technology enterprise at the Agency in its review of NASA's Space Technology Roadmaps. The NRC wrote in their February 2012 report, "The productivity and the effectiveness of technology development programs are diminished when the direction, content, and/or funding of those programs abruptly change from year to year." If NASA and this Nation are to reach the goals set for us by this Congress, we must drive to innovate. The NRC made a stark observation, "Success in executing future NASA space missions will depend on advanced technology developments that should already be underway." The Space Technology Program addresses this technology deficit. It reaches beyond today's missions to develop and demonstrate technology for infusion into future missions. In doing so, it also benefits the aerospace industry and other government agencies. At the same time, NASA's Mission Directorates continue to develop "pull" technologies, which are those solutions that target specific, near-term missions. With this balanced approach of near and farther-term investments, NASA is now able to meet the needs of today's missions while investing in the revolutionary advancements that will enable even more amazing achievements in our future.

The space technology roadmapping effort that the NRC just finished reviewing aids NASA in formulating a balanced, cross-agency, technology investment perspective by identifying technology needs and overlaps, which will better ensure infusion of technologies into future missions conducted by NASA, industry or other Government users. The NRC engaged broad and crosscutting segments of our external stakeholders and the report's findings and recommendations represent a true consensus of the aerospace community. The NRC's final report provides guidance for future competitive and guided technology investments. NASA is investing, at some level, in all 16 of the high-priority research technologies referenced in the report. In 2012, OCT will lead an Agency-wide analysis and coordination effort to inform NASA's future technology investments on the basis of the NRC report. In addition, OCT will continue to work with NASA Mission Directorates and cross-Agency working groups to identify broadly-applicable technology needs.

Space Technology

The Office of the Chief Technologist (OCT) coordinates the Agency's technology programs, one of which is the Space Technology Program. The FY 2013 budget requests $699 million for the Space Technology Theme. This request is driven by the needs of existing projects as teams across the nation ready hardware to fly and test in FY 2013. OCT identifies development needs, prioritizes those needs according to stakeholder input, and reduces duplication to ensure that the Agency's resources are used wisely. By coordinating technology programs across NASA, OCT facilitates infusion of available and new technology into operational systems that ultimately advance specific human-exploration missions, science missions, and aeronautics capabilities.

Within the Partnership Development and Strategic Integration account within Space Technology, OCT engages the larger aerospace community, including other Government agencies to develop partnerships and leverage shared resources and expertise, efficiently developing breakthrough capabilities. The FY 2013 budget request includes $29.5 million to develop these partnerships, lead the Agency strategic roadmapping efforts as described above, and to manage NASA's technology transfer and commercialization. OCT works with all NASA Mission Directorates and Centers to ensure NASA makes available Agency-developed technologies, processes, discoveries, and knowledge to the private sector. Technology transfer and commercialization is conducted through various means including releasing licenses, forming partnerships, and through cooperative activities. These transferred technologies are used to create products, services, cascading innovations, and other discoveries to fuel the Nation's economic engine and improve our quality of life.

OCT is also responsible for coordinating, monitoring and evaluating all Agency prizes and design

challenges conducted by NASA mission directorates using the authority seen in the America COMPETES Reauthorization Act of 2010. Since enacted, the Agency has realized the value of prizes and challenges across many of NASA's research and technology domains. For example, public innovators have improved our abilities to determine the shape of galaxies; identified algorithms to better process remote sensing data; and developed algorithms to aid NASA in quickly identifying and detecting impact craters within large volumes of data.

OCT engages the Nation's "citizen inventors" through prize-based challenges in areas such as satellite launch systems, advanced robotics, energy storage, green aviation, advanced materials, and wireless power transmission. Prize authority from Section 304 of the Space Act facilitates the highly successful Centennial Challenge program. In 2011, the Green Flight Centennial Challenge drove advancement in aerodynamics, aircraft configuration design, power plants, and flight path planning leading to dramatic increases in the State of the Art for fuel efficiency and noise. Current Centennial Challenges include: Sample Return Robot, Night Rover and Nano-Satellite Launch.

By offering prize awards NASA is acquiring technology and fostering innovation for the agency, dramatically increasing the number and diversity of minds tackling tough problems, and engaging a broad non-traditional community of innovators ranging from professionals and small companies to backyard garage inventors.

In managing the Space Technology Program (STP) this Committee authorized, OCT employs a portfolio approach, investing in both crosscutting and human exploration specific technology needs for the Agency. The broadly relevant technologies being pursued within STP span a range of discipline areas and technology readiness levels (TRL) from concept study to flight demonstration, including technology demonstrations conducted on the ISS. Space Technology development takes place using NASA centers, academia and industry, and through partnerships with other Government agencies and international partners. NASA also participates in national technology-development initiatives such as the National Robotics Initiative and the Advanced Manufacturing Partnership to increase opportunities for collaborative technology development. Investments include both competitively awarded and strategically-guided activities to address long-term Agency technology priorities and technology gaps identified within the previously discussed Agency's space technology roadmaps.

The development, testing, and evolution of an array of space technologies for human missions beyond low Earth-orbit (LEO), include propulsion, logistics and resupply, life sciences and human systems, communications, and many other areas, to safely extend human presence to multiple destinations throughout the solar system robustly, sustainably and affordably. Space Technology funds these technology efforts through Exploration Technology Development for which the budget request includes $202 million. Using these funds, NASA is working toward a FY 2016 flight demonstration to test long-term storage and transfer capabilities for cryogenic fluids. Improved capabilities in this area, in combination with the Space Launch System heavy-lift vehicle, will bring deep-space exploration closer to reality. In addition, Boeing and a team of engineers from four NASA centers are working together to develop two large-scale, lightweight composite cryogenic propellant tanks for validation testing in FY 2013 that promise to achieve weight and cost savings as compared to traditional aluminum lithium tanks and may be used on future heavy-lift launch vehicles. The NASA Glenn Research Center is accelerating work on in-space propulsion, space power generation, and storage ground-based technology development efforts required to reduce risk for a future planned solar electric propulsion demonstration. These capabilities will enable efficient deep-space transportation that is required for deep-space human and scientific exploration.

In addition, Space Technology invests in crosscutting technologies that could benefit human exploration,

and also change the way science missions are conducted. These activities are funded through this theme's Crosscutting Space Technology Development account for which the request is $293.8 million. Crosscutting technology work in development includes several high priority efforts including the following activities:

- at the Goddard Space Flight Center (GSFC) in Maryland, a team is developing a laser-based, deep space communications system that will revolutionize the way we send and receive data, video and other information, using lasers to encode and transmit data at rates 10 to 100 times faster than today's systems, which will be needed for future human and robotic space missions.
- at the Jet Propulsion Laboratory (JPL) in California, a team is developing a Deep Space Atomic Clock, which utilizes a key component from the Johns Hopkins Applied Physics Laboratory. When fully developed, this technology will dramatically improve navigation and guidance in future deep-space missions and may lead to an improved Global Positioning System (GPS) for use on Earth.In partnership with the Human Exploration and Operations Mission Directorate, a team at GSFC is pioneering the technologies required for satellite servicing. When matured, this technology will allow robotic spacecraft to repair, refuel, relocate and service existing orbiting spacecraft; and
- Space Technology is working with a L'Garde Inc. in Tustin, CA to develop the largest solar sail ever flown. Once developed, this propellant-free propulsion system will enable the next generation space weather monitoring system.

Space Technology is working closely with the Science and Human Exploration and Operations Mission Directorates on an integrated strategy for Mars exploration that will support science as well as human exploration goals. Entry, descent and landing (EDL) technology is one opportunity where collaborative development can enable future scientific and human planetary missions. Dramatic improvements must be made with EDL technologies to enable delivery of large science payloads to the polar regions of Mars, or to deliver critical infrastructure needed for extended human missions. Currently, at JPL and the Langley Research Center in Virginia, engineers are working to develop lightweight planetary entry systems that will enable large mass, high elevation and pinpoint landing capabilities required for Mars and other planetary destinations. These advanced technologies will be tested through balloon and rocket flights managed by the Wallops Flight Facility in Virginia. Also in FY 2013, the Space Technology EDL teams will be analyzing the data returned from the instrumentation package installed in the heatshield of the Mars Science Laboratory entry vehicle after making its flight through the Martian atmosphere this August.

The Space Technology theme also includes $173.7 million for the Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR), which encourage small business owners to provide technical innovations. SBIR and STTR continue to support early-stage research and development performed by small businesses through competitively awarded contracts. These programs produce innovations for both Government and commercial applications. SBIR and STTR provide the high-technology small business sector with an opportunity to develop technology for NASA, and commercialize that technology in order to provide goods and services that address other national needs based on the products of NASA innovation.

In all, the Space Technology Program has funded roughly 1,000 technology projects and engaged thousands of engineers and technologists since its inception in 2011. Many of these projects have hardware ready to test and fly in FY 2013 as they mature their technology for infusion into a future mission or capability.

International Space Station

The International Space Station is fully complete. Many consider it to be one of humanity's greatest technological achievements. Its state-of-the-art research facilities support a wide variety of research disciplines. Examples include high-energy particle physics, Earth remote sensing and geophysics experiments, protein crystallization experiments, human physiology research (including bone and muscle research), radiation research, plant and cultivation experiments, combustion research, fluid research, materials science experiments, and biological investigations. The three major science laboratories aboard the ISS – the U.S. Destiny, European Columbus, and Japanese Kibo facilities, along with external test beds – enable astronauts to conduct experiments in the unique, microgravity and ultra-vacuum environment of LEO, experiments that simply cannot be conducted on Earth. The range of research disciplines that ISS supports means that R&D conducted aboard Station promises new discoveries not only in areas directly related to NASA's exploration efforts, but in fields that have terrestrial applications, as well. The ISS will provide these opportunities to scientists, technologists and engineers through at least 2020. For example, a Space Technology team at the Johnson Space Center in Texas is working to build on the Robonaut 2 demonstration on ISS and further the Agency's development of next-generation tele-robotics systems. In addition, Space Technology is using the SPHERES satellites on ISS to demonstrate autonomous rendezvous and docking techniques and liquid slosh dynamics which serves to validate mission design for both spacecraft and launch vehicles.

In the NASA Authorization Act of 2010 (P.L. 111-267), Congress directed that the Agency enter into a cooperative agreement with a not-for-profit organization to manage the activities of the ISS National Laboratory. Last fall, NASA finalized an agreement with the Center for the Advancement of Science in Space (CASIS) to manage the portion of the ISS that operates as a U.S. National Laboratory. CASIS will be located in the Space Life Sciences Laboratory at the NASA Kennedy Space Center. This independent, nonprofit, research-management organization will help ensure the Station's unique capabilities are available to the broadest possible cross-section of U.S. scientific, technological and industrial communities.

CASIS will develop and manage a varied R&D portfolio based on U.S. national needs for basic and applied research, establish a marketplace to facilitate matching research pathways with qualified funding sources, and stimulate future interest in using this national lab for research and technology demonstrations and as a platform for science, technology, engineering and mathematics education. The goal is to support, promote and accelerate innovations and new discoveries in science, engineering and technology that will improve life on Earth.

In addition to the direct research benefits to be gained by the ISS as a National Laboratory, this innovative arrangement also supports NASA's effort to promote the development of a LEO space economy. National Lab partners can use the unique microgravity environment of space and the advanced research facilities aboard Station to enable investigations that may give them the edge in the global competition to develop valuable, high technology products and services. Furthermore, the demand for access to the ISS will support the providers of commercial crew and cargo systems. Both of these aspects of the ISS as a National Laboratory will help establish and demonstrate the market for research in LEO beyond the requirements of NASA.

Technology in Human Exploration

Consistent with NASA's technology roadmaps, the Advanced Exploration Systems (AES) Program within the Agency's Human Exploration and Operations Mission Directorate (HEOMD) is pioneering new approaches for rapidly developing prototype systems, demonstrating key capabilities, and validating operational concepts for future human missions beyond Earth orbit. AES activities are uniquely related to crew safety and mission operations in deep space, and are strongly coupled to vehicle development in the

immediate future. While the Space Technology programs are focused on demonstrating particular technologies, AES focuses on early integration and testing of prototype systems. Both Space Technology and AES activities seek to reduce risk and improve affordability of exploration mission elements. The prototype systems developed in the AES program will be demonstrated in ground-based test beds, field tests, underwater tests, and flight experiments on the ISS. Successful prototypes will evolve into larger integrated systems and mission elements that will be tested on ISS before we venture beyond Earth orbit.

In addition to developing building blocks for future missions, the AES and Space Technology programs are exploring innovative ways to drive a rapid pace of progress, streamline project management, and use NASA's resources workforce more effectively. By using small, focused projects to rapidly develop and test prototype systems in house, NASA expects to greatly reduce lifecycle costs and minimize the risk of incorporating new technologies into system designs.

The AES and the Space Technology Programs work closely together to incorporate and integrate new technologies and innovations as they are matured to the point of infusion. The AES Program is also working closely with NASA's Science Mission Directorate to pursue a joint program of robotic precursor activities that will acquire critical data on potential destinations for future human missions such as the Moon and Mars and its moons. This program builds upon the successful collaboration between science and exploration on the Lunar Reconnaissance Orbiter mission.

NASA Aeronautics Technology

NASA continues to lay the foundation for the future of flight by exploring new ways to manage air traffic, build more fuel-efficient and environmentally friendly airplanes, and ensure aviation's outstanding safety record. Through the research we conduct and sponsor with universities and industry, we help to develop the technology that enables continuous innovation in aviation.

Aviation is an integral part of our daily lives, a critical part of the foundation of our economy, and a source of strength in the global market. Technological superiority has been a key enabler for the U.S. aerospace manufacturing industry to be the world leader in the aviation sector. In this time of continuing economic challenge, the aviation industry provides high-tech, highly rewarding, and high-paying jobs that Americans are proud to have.

U.S. companies currently enjoy strong positions in the global commercial aerospace market, including manufacturers of large civil aircraft, engines, business jets and helicopters, as well as structures, components and electronics. NASA-developed technologies are in the DNA of many of the civil and military aircraft the U.S. industry has developed and marketed to date. Boeing, General Electric and Pratt & Whitney have all introduced highly competitive products in the last two years. With the introduction of these new products, the U.S. manufacturers appear to be well positioned in the large commercial transport market for some time to come. However, this is not a guarantee and careful attention to aeronautics investment is required to maintain U.S. leadership in this area.

We continue to invest in aeronautics Research and Development, recognizing its potential to address emerging challenges and enable innovative capabilities in the next generation of products. These new capabilities could result in substantially more energy-efficient, significantly less polluting, and considerably quieter subsonic transport through completely new designs.

NASA is investing in cutting edge research to accelerate implementation and enhance the capabilities of the Nation's Next Generation Air Transportation System (NextGen) in partnership with the FAA and

other Joint Planning and Development Office partners. With our partners, we are investing in critical areas of research such as new air traffic management concepts for new fuel-efficient arrival procedures. And we are leading the country with a vision and revolutionary capabilities for the Nation's future air transportation system, researching concepts and technologies that may provide the foundation for future commercial products and services brought to the market.

We transfer the results of fundamental and systems-level aeronautics research to the aerospace community through dissemination of research results, concepts, and design methods. In some instances, companies may build on specific technologies and capabilities developed through NASA research, investing their own research and development dollars to take those last steps to become a commercialized product. In other instances, NASA provides design methods and understanding used by companies in developing new products. By maturing new technologies and validating design methods, NASA research can decrease the risk of incorporating new technologies and systems in aircraft, shortening the path through safety certification in the Federal Aviation Administration and speeding the transition of new technologies into the fleet.

U.S. companies are well positioned to build on discoveries and knowledge resulting from NASA research, turning them into commercial products, benefiting the quality of life for our citizens, providing new high-quality engineering and manufacturing job opportunities, and enabling the United States to remain competitive in the global economy. Concept simulations and field trials in real flight environments of NASA developed technologies have demonstrated the potential for significant monetary savings to airspace users through reduction in flight delays and fuel usage.

Technology Research & Development to Enable Scientific Discovery

NASA's Science Mission Directorate (SMD) develops and operates innovative space missions that push out the frontiers of scientific knowledge of the Earth, the Sun, our solar system, and the universe beyond. In Earth Science, the challenge is to be able to detect a small but influential signal of change against a background of much larger short-term variability. Through technological advances we have been able to measure millimeter changes in global ocean surface height, and distinguish the influence of solar variability from other factors driving atmospheric warming. In Heliophysics, we have been able to do what your mother told you never to do—stare at the Sun—to observe the connections between coronal mass ejections and aurorae over Earth's poles. In Planetary Science, development of Advanced Stirling Radioisotope Generators promise to power spacecraft operating in deep space with one-sixth the amount of plutonium-238 as conventional radioisotope power systems. In Astrophysics where the challenge is to peer ever deeper into the universe and farther back in time, large segmented mirrors, sensitive optics that operate at 40 Kelvin, and a host of other technologies are enabling us to build the James Webb Space Telescope. These missions require technologies that in many cases would not be developed otherwise—some of which find applications not imagined by their inventors.

The technologies SMD develops and employs span the full range of the process of scientific discovery, from theory and mission design to science data processing and distribution. They include spacecraft components and systems, scientific instruments, and advanced information technologies. Spacecraft technology has advanced sufficiently that we can acquire standard spacecraft buses for many Earth observing missions from industry, and our technology focus here is on areas such as on-board data processing, formation flying, and autonomous operations that enhance scientific productivity and operational utility. For planetary exploration and astrophysics, however, spacecraft and instruments are much more integrated and more specialized, requiring technology advances in power, propulsion, stability, deployment, communications, and radiation protection, among others. For all SMD science areas, science instruments are "the pointy end of the spear" of space missions, and technology advances

are continually required on all fronts. This is the largest area of SMD technology investment. To enable instrument technology development, SMD uses suborbital research platforms (sounding rockets, aircraft, and balloons) to test instruments as prototypes of those that will eventually fly in space. Advanced information technologies include high-end computing (where software must be written to make effective use of industry's leading supercomputers), and data mining capabilities to enable knowledge to be efficiently derived from enormous data sets.

SMD develops technologies for its science missions largely through open, competitive solicitations to garner the best ideas from industry, academia, and other government laboratories. SMD's annual Research Opportunities in Space and Earth Sciences (ROSES) solicitation includes specific, scheduled calls for technology development proposals in defined areas of need. In addition, targeted technology investments are made in such areas as Advanced Stirling Radioisotope Generators (ASRGs) when specific partnerships are required. Generally, SMD develops technologies outside of mission projects, and mission projects are not confirmed to proceed to development until required technologies are sufficiently mature. In addition, SMD uses the attached payload accommodations on ISS to provide the environment and resources for science experiments making specific atmospheric, Sun-Earth interaction, and astrophysics observations compatible with ISS's orbital inclination and altitude. Technology is the great enabler of NASA science missions, and thus of discovery in the Earth and space sciences and NASA's impact on our nation's economy, environment, and education goals.

Conclusion

America is beginning an exciting revolutionary new chapter in human space exploration and scientific discovery. This chapter centers on full use of the International Space Station, maturation of multiple American vehicles for delivering astronauts and cargo to low-Earth orbit, and development of a crew vehicle and an evolvable heavy-lift rocket--two essential building blocks for our nation's future in deep-space exploration. NASA is moving forward with the James Webb telescope and will be exploring Mars later this year with the highly capable Curiosity rover. The rapid development and infusion of new in-space technologies is critical to advancing our future in space. They will enable explorers to safely venture into deep space for the first time.

Pushing the boundaries of aeroscience and taking informed-risks, NASA and our Nation remain at the cutting-edge. By making steady investments in technology, we will enable future human and robotic exploration of near-Earth asteroids, the Moon, and Mars just as current and past mission successes were supported by decades of vital technology investments.

Investments in research and development enable new missions, stimulate the economy, contribute to the Nation's global competitiveness and inspire the Nations' next generation of scientists, engineers and explorers. As a professor at Cornell University, I have had the honor of working with talented faculty and students who share my passion for space. For most of the past decade, very few of us who have wanted to contribute to the Nation's civil space program have had the opportunity to do so. Since OCT was established, NASA is tapping into the enormous enthusiasm for the Agency's mission we see from academia, industry, and the public. The desire to engage with NASA is overwhelming. We see this in the fact that OCT receives thousands more proposals to its solicitations than it can afford to fund. And I have seen it personally, in the hundreds of students who have worked with me on two university-built satellite projects.

NASA must continue to cast a wide net to bring in the best ideas, wherever they may be found. A NASA focused on advancing technology helps ensure that high-tech jobs will be available for these young people when they complete their studies. And in sponsoring this sort of research and development, it will do its part to encourage the next generation of aerospace engineers, ensuring that our Nation retains the critical capabilities in advanced technology that will ensure its economic competitiveness.

Two weeks ago the Nation celebrated the 50th anniversary of Senator John Glenn's historic orbital flight. Only a few months before the historic flight of *Friendship 7*, President Kennedy gave the Nation a grand challenge to land a human on the Moon and return them safely back to Earth. It was a bold goal that would provide the ultimate challenge to our Nation, and forced us to "organize and measure the best of our energies and skills." It required NASA to tackle enormous technological unknowns by utilizing American ingenuity and innovation. In accomplishing the goal, a whole generation of engineers and scientists introduced the term "rocket science" into American popular culture and made a lasting imprint on the economic, national security and geopolitical landscape.

America can do the same today. Our Nation's future economic success is tied to our ability to out-innovate the rest of the world. NASA is an important part of this future. America expects boldness from NASA. We are now returning to our innovation roots, taking the long-term view of technological advancement that is essential for accomplishing our missions. America expects no less.

Mr. Chairman, thank you for your support and that of this Committee. I would be pleased to respond to any questions you or the other Members of the Committee may have.