

**SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION:
QUESTIONS FOR THE RECORD**

**HEARING ON
NASA AT A CROSSROADS: REASSERTING AMERICAN LEADERSHIP IN SPACE EXPLORATION
Wednesday, July 13, 2016**

**Questions for Professor Dan Dumbacher, Professor of Engineering Practice, Purdue
University**

From Senator Rubio

Question 1. Kennedy Space Center and the state of Florida is the world's space capital with the largest concentration of aerospace launch providers and suppliers. We've already seen Apollo, Shuttle, and ISS cargo launches from there and soon both Commercial Crew and SLS/Orion will be launching. Could you discuss what this means for the future of Florida's Space Coast, and what you foresee happening in the State in the next few years?

Kennedy Space Center (KSC) and the state of Florida is, and will continue to be, the primary space launch “hub” for United States space endeavors as the Nation’s Spaceport. The work of preparing spacecraft, preparing launch vehicles, and launching vehicles to orbit is on the critical path to establishing a permanent human presence in space and expanding our economic sphere. KSC and the state of Florida are “launching” the majority of exploration and commercial activities needed to continue development of space for the future. Providing launch infrastructure for emerging space utilization activities and exploration beyond low earth orbit will expand United States leadership, and the peaceful uses of space for global society.

Question 2. During the birth of the Apollo program, the United States, under the leadership from President John F. Kennedy, was determined to beat the Soviets to the moon. Is the United States still in a position to remain competitive and challenge the likes of other global powers?

The United States is definitely in a position to remain competitive based on its current and long-time leadership of human space exploration. The principle threat to not being competitive is the United States abdicating this leadership through lack of commitment, inattention, or naiveté. Therefore, the United States, must continue to act, develop the commercial cargo and crew opportunities for transportation to and from low Earth orbit, maintain productive use and permanent presence at the International Space Station, lead development of capabilities for astronauts to explore, and extend permanent human presence beyond low earth orbit.

The United States won the race to the moon (Mercury, Gemini, Apollo), initiated routine access to space (Space Shuttle), learned how to live and work in space (Skylab, Spacelab, ISS), developed International Partnerships (Apollo–Soyuz, Spacelab, Shuttle-Mir, ISS),

and is now building the strategic relationship between government exploration and enabling the commercial development of space (Commercial Cargo, Commercial Crew, NextSTEP). Each of these steps builds upon the previous phase, was difficult to accomplish, and was a vital step. The United States and NASA were successful in each and will be successful in the future. United States leadership continues to build the narrative to establish permanent human presence in space.

With this hard earned experience, the United States, with continued Administration and Congressional leadership, can remain the global space exploration leader. This leadership needs to be demonstrated with clear political communication on the value and “why” we explore space, and building the narrative for permanent human presence in space.

History clearly shows that the nations continuing to explore new horizons, solving new challenges, and leading other nations to settle new lands, maintain their leadership and prestige in the world. The United States is at a key crossroads, one that will determine whether we continue to take on new challenges, enhancing our global leadership, or whether we will build walls and focus internally. It is essential that the United States political leadership recognize and clearly communicate the goals and objectives, and shape the clear narrative for long term sustainability and investment in space exploration. In today’s environment, the narrative must be built upon the value of a nation continuing to search beyond the next horizon. In doing so, our nation can garner the enormous political, national defense, scientific, technological, and economic value from space exploration.

There is also an urgency in maintaining and building the United States leadership in space. We are the global leader in the space economy and thus in a position to establish the precedents that others will follow. With the number of international and commercial actors and activities rapidly increasing in numbers and scope, the United States must actively engage and stay in the lead to establish the space frontier “rules of the road” based on American values. Permanent human presence in space is required to do this.

For the benefit of the generations that follow us, the continued excellence of the United States, we MUST push ourselves to explore and utilize space, grow our industrial and technological base and skills, lead and work with other countries, continue to take on the hard challenges, and expand the human neighborhood in and beyond low earth orbit

Question 3. As the Senate looks to reauthorize NASA in the coming year, what reforms do you suggest?

The next NASA Authorization bill is extremely important for the future of space exploration to build on current programs and achievements. A clear reaffirmation of the goals and objectives from the 2010 NASA Authorization Act (Public Law 111-267), particularly “to expand human presence beyond low earth orbit, and to do so, where practical, in a manner involving international partnerships.” Reaffirmation and building

on this long-term goal will drive space exploration enterprise stability, sustainability, and prepare for the next steps, thereby minimizing the “stop/start” churn NASA has experienced in the past.

Congress at every opportunity, particularly following a national election, needs to clearly state and reaffirm the guiding goals and objectives for the use and exploration of space and avoid a major “reset” that can lead to policy confusion, programmatic uncertainty, and accompanying wasteful and inefficient use of valuable human and financial resources. The goal should not be just for NASA to place humans on the surface of Mars or, like Apollo, it will be perceived that boot prints mean exploring is done. The next NASA Authorization Act must clearly delineate the goal of humans permanently in space and beyond low earth orbit.

It is also essential to continue the 2010 Authorization Act mandates on Key Objectives to deliver value to the Nation in key areas such as building the foundation for sustainable economic activities in space, supporting U.S. security and global competitive posture, advancing knowledge of the universe, and inspiring young people. United States permanent human presence in space, with the rapidly growing international and commercial activity, is required for the United States to lead the establishment of the space frontier “rules of the road” in a manner consistent with American values. This is the source of the urgency, as other actors take on greater activity in space, the window for U.S. leadership in establishing the “rules of the road” is closing.

Specific suggested NASA Authorization Act reforms include:

1. Build on and refine the 2010 NASA Authorization Act’s long term goal to be:

The long term goal of the human spaceflight and exploration program of the United States is to expand permanent human presence beyond low-Earth orbit in a way that will enable human settlement and a thriving space economy.

This will be best achieved through public - private partnerships and international collaboration.

This goal was a consensus statement of a diverse group of over 100 space leaders from academia, government and industry at the 2015 Pioneering Space National Summit. All of the participants agreed that this statement is consistent with, and builds upon, the 2010 NASA Authorization Act. This national journey will serve many national interests and benefit the American people.

2. Mandate that NASA specifically address this goal in its strategic planning;

- 3. Mandate that NASA on a yearly basis report to Congress its progress in pursuing this goal, and report on policy or other impediments that stand in its way of doing so;**
- 4. Mandate that NASA on a yearly basis report to Congress its progress in implementing recommendations of the 2014 National Academy's Pathways to Exploration Report, and report on policy impediments that stand in its way of doing so, or provide sound rationales for different direction than that recommended by the report;**
- 5. Based on the selected goals and objectives for NASA, Congress needs to clearly define the resources to be made available for space exploration. The resources must grow consistent with the expected work to be accomplished on a reasonable schedule and account for inflation to avoid loss of buying power.**
- 6. Provide NASA the ability, within its Budget Authority, to have a single appropriations line for Exploration Systems to permit the efficient use of resources for attaining the necessary technical and schedule objectives. Multiple appropriations lines greatly complicate the program management of the SLS, Orion, and Ground Systems development. Further fragmentation of funding into smaller and smaller accounts effectively inhibits sound program management and inevitably drives up the cost of programs while introducing greater risk. As additional elements such as habitats are added to the exploration portfolio, the ability to efficiently address programmatic issues is essential for efficient use of valuable taxpayer resources;**
- 7. Provide NASA the programmatic and technical discretion to implement the plans necessary to meet the goals and objectives consistent with available resources, and appropriate Congressional oversight;**
- 8. Require NASA to evaluate and use programmatic and technical best practices from other industries and government agencies. Consideration should be given to a NASA version of DARPA to allow new methodologies to be tried unencumbered by the traditional and bureaucratic approaches. It is imperative that NASA remain at the forefront of technology and program management. NASA developed the systems engineering and program management tools necessary for Apollo. These tools have served this Nation well as programs have increased in complexity. The landscape is evolving with emerging space companies and the government role of tackling the technical challenges, and NASA must be flexible while assuring the safety and appropriate use of taxpayer resources. This necessitates a continual learning organization, willing to experiment and test new technical and program management methods.**

Question 4. What programs within the agency pull its focus away from its intended main goal of placing humans on the surface of Mars?

The 2010 NASA Authorization Act clearly states the goals and objectives for NASA and its respective mission directorates. These goals and objectives are defined for human space exploration, Earth Science, Space Science, Aeronautics, and Education. Relative priority is established by the Administration and Congress based on the respective value provided to the Nation.

Consistent with the long-term goals and objectives to expand human presence beyond low earth orbit to enable human settlement and a thriving space economy via public-private partnerships and international collaboration, Congress should consider increasing the investment in NASA to at least double the expected inflation rate. This would be a rational investment for the future within the constraints of the current and expected fiscal environment, provide an improved foundation for our Country's future, and assure U.S. leadership in space.

Even in the difficult current fiscal environment, with many needs and demands placed on the federal government, a steadily increasing investment for our future is appropriate. Not only do such investments help grow the economy through advancements in competitiveness and innovation, and thus pay for themselves in the long run, they ensure the realization of future economic opportunities for our citizens and our children, which are essential. As all U.S. citizens see more opportunities for themselves, their families, and their communities, hope for the future is increased, and provides the foundation for an optimistic and engaging vision of the future for all our citizens. Space exploration, is and will continue to be an important pathway towards new economic opportunities, and the development of new technologies, all leading to a better future for all.

It is imperative that Congress and the Administration demonstrate the leadership required to build a better future with the benefits of space exploration. NASA's accomplishments and lessons learned through the decades have provided inspiration, new economic opportunities and new technologies that are an important part of our international leadership, national defense, and emerging commercial opportunities.

Would we be satisfied if we turned off GPS for a day, did without weather satellites or space based communications, did not have astronauts running experiments for new medicines, new materials, and learning how to live and work in space with direct application to the human ageing process, understanding our solar system through our rovers and planetary probes, obtaining a better understanding of the cosmos through our telescopes, and providing more efficient means for commercial air travel? I think not.

I believe a modest increase in NASA's funding at double the expected rate of inflation is the appropriate funding level to be included in the next NASA Authorization Act.

