Statement of
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before the

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Committee on Commerce, Science, and Transportation
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Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to appear today along with the other recipients of scientific Nobel Prizes, all representing the tremendous scientific achievements that the United States can make to the benefit of the world. I currently serve as the Chief Scientist for the Science Mission Directorate at NASA Headquarters, and am also the Senior Project Scientist for the James Webb Space Telescope at NASA's Goddard Space Flight Center.

My Inspirations

I am very proud of the support that our great Nation has given to science over the years, from both private and public sources. Benjamin Franklin was one of the great scientists of his time, and he put his personal credibility on the line to persuade the King of France to support the colonists in their fight for freedom. Thomas Jefferson sent off the Nation's first scientific expedition to explore the route to the Pacific Ocean. Industrial tycoons and taxpayer support in the 19th and 20th century built libraries and museums and the world's greatest ground-based telescopes, establishing U.S. leadership in education for the people and in astronomy in particular. When I was eight-years-old, I visited the American Museum of Natural History and the Hayden Planetarium in New York, and I was amazed to imagine that scientists could now hope to find out how the universe began, how volcanoes and earthquakes work, and how life might have come to be possible here on Earth. When the Sputnik was launched, the Nation saw once again that science was essential to our security, and suddenly public schools had science fairs, high school students went off to National Science Foundation-supported college courses over the summer, and NASA was formed to respond to the new challenge. Only a few years later, President Kennedy launched the Apollo program to show that the U.S. as a free nation was also a leader of science and technology. And James Webb, NASA's second Administrator, persuaded President Kennedy that the Apollo program should include serious scientific work for the good of the U.S., and was not just a foreign policy statement.

I was a young graduate student at the University of California in Berkeley when our astronauts reached the moon, and soon after that I was working on measuring the cosmic microwave background radiation for my thesis research. This is the residual heat radiation of the great Big Bang that happened 13.7 billion years ago. I was supported in this work by several Federal agencies, and by a private scholarship from the Fannie and John Hertz Foundation. Only six months after completing my PhD in 1974, I was organizing a proposal for submission to NASA to measure this radiation much better. As it turned out it was an excellent idea, and turned into a successful satellite mission called the Cosmic Background Explorer. 15 years later, in 1989, it was launched, and we immediately found very strong evidence confirming the Big Bang theory. And just 17 years after that, our work won the

Nobel Prize in Physics for 2006. I believe that this prize recognizes the unique capability that the U.S. possesses, to put scientists and engineers together to build new tools that have never existed before, to discover what has never been known before.

NASA's Role in Promoting Science, Technology, Engineering, and Mathematics

As a nation, we must encourage our students to pursue opportunities in science, technology, engineering, and mathematics (STEM). NASA is in a unique position to offer groundbreaking opportunities in these areas to engage students and provide long-term career paths. The President's Vision for Space Exploration calls upon NASA to conduct robotic and human exploration of the Moon, Mars and other destinations, to conduct robotic exploration across the solar system, and to conduct advanced telescope searches for Earth-like planets around other stars. Other Presidential directives and legislative mandates instruct NASA to conduct Earth observation and scientific research and to explore the origin and destiny of the universe.

As a critical component of achieving NASA's mission, the Agency's education activities reflect a balanced and diverse portfolio of Elementary and Secondary Education, Higher Education, e-Education, Informal Education, and Minority University Research and Education. Through its unique mission, workforce, and facilities, NASA is leading the way to inspire interest in STEM careers, as few other organizations can. Our efforts have also made significant impacts in engaging underserved and underrepresented communities in STEM.

Accordingly, we are preparing the pathway for the next generation with great anticipation. These "explorers and innovators of the new millennium" must fully represent our Nation's vibrant and rich diversity. Furthermore, we will support our Nation's universities, colleges and community colleges by providing exciting research and internship opportunities that "light the fire" and "fuel the passion" for a new culture of learning and achievement in STEM.

NASA's educational activities are designed to inspire, engage, educate, and employ our Nation's talented youth. As contributors to achieving the Nation's goals, NASA is committed to three primary objectives to help improve the state of STEM education in our country:

1. **Strengthen NASA and the Nation's future workforce** – NASA will identify and develop the critical skills and capabilities needed to ensure achievement of the Vision for Space Exploration, science, and aeronautics.

2. **Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty -** NASA will focus on engaging and retaining students in STEM education programs to encourage their pursuit of educational disciplines critical to NASA's future engineering, scientific, and technical missions.

3. **Engage Americans in NASA's mission** – NASA will build strategic partnerships and linkages between STEM formal and informal education providers. Through hands-on, interactive, educational activities, NASA will engage students, educators, families, and the general public to increase America's science and technology literacy.

Within NASA science, a broad spectrum of education activities are sponsored, ranging from kindergarten to postgraduate levels. All NASA's science missions and programs must have an education and public outreach component. Through a competitive, peer-review selection process, NASA provides funding dedicated to education and public outreach to researchers. NASA also sponsors graduate and post-doctoral fellowship opportunities. In addition, the Agency is looking for new ways to provide increased opportunities for students to gain greater experience developing and launching their own science instruments, either in conjunction with science missions or through its suborbital rocket and balloon programs.

NASA is truly a premier Agency in its ability to reach out and inspire students. This is exemplified in part by the fact that NASA alone was responsible for 11 percent of *Science News* magazine's top stories--covering all fields of science-- for 2006; this is an all-time record in the 34 years that this metric has been tracked. Important findings resulting from NASA's science programs ranged from new observations of familiar phenomena like the ozone hole, hurricanes, and rainfall, to the discovery of lakes of organic hydrocarbons on Saturn's planet-sized moon Titan, to the identification of new classes of planetary abodes across our galaxy, to the study of the Sun's magnetic field, showing it to be more turbulent and dynamic than previously expected.

In October 2006, NASA's twin STEREO spacecraft were launched to help researchers construct the first-ever three-dimensional views of the Sun's atmosphere. This new view will improve our abilities in space weather forecasting and greatly advance the ability of scientists to understand solar physics, which, in turn, enables us to better protect humans living and working in space.

From across the solar system, NASA's spacecraft have provided startling new insights into the formation and evolution of the planets. Images from the Mars Global Surveyor have revealed recent deposits in gullies on Mars, evidence that suggests water may have flowed in these locations within the last several years. The Mars Reconnaissance Orbiter, which began its primary science phase in November 2006, has not only taken extraordinary high resolution images of Mars at resolutions greater than any other mission to-date, but has taken incredible images of Opportunity and Spirit on the surface, and helped the Phoenix lander find a safe landing area. From its orbit around Saturn, the Cassini spacecraft recently found unexpected evidence of liquid water geysers erupting from near-surface water reservoirs on Saturn's moon Enceladus.

Additionally, the Wilkinson Microwave Anisotropy Probe (WMAP) Explorer mission, which I helped to propose, was able to gather new information about the first second after the universe formed, while the Chandra X-ray Observatory provided new and strong evidence of dark matter, and the Hubble Space Telescope identified 16 candidate planets orbiting other stars near the center of our galaxy.

Using instruments flying closer to Earth, NASA investigators flew 29 separate scientific instruments to 60,000 foot altitudes aboard NASA's WB-57F Canberra aircraft in the Costa Rica Aura Validation Experiment (CAVE). These airborne measurements, coupled with measurements from the orbiting Aura spacecraft, shed light on how ozone-destroying

chemicals get into the stratosphere over the tropics and how high-altitude clouds affect the flow of water vapor – a powerful greenhouse gas – in this critical region of the atmosphere. This is fundamental basic work on the physical and chemical processes of the atmosphere.

Examples of important successes in our data analysis programs are also diverse. Astronomers combining data from the Hubble Space Telescope with data from ground-based and other space-based telescopes have created the first three-dimensional map of the large-scale distribution of dark matter in the universe. NASA researchers also found organic materials that formed in the most distant regions of the early solar system preserved in a unique meteorite that fell over Canada in 2000. And, using a network of small automated telescopes, astronomers have discovered a planet orbiting in a binary star system, showing that planet formation very likely occurs in most star systems. In our home solar system, scientists predicted that the next solar activity cycle will be 30-50 percent stronger than the previous one and up to a year late. Accurately predicting the sun's cycles will help plan for the effects of solar storms and help protect future astronauts. And a breakthrough "solar climate" forecast was made with a combination of computer simulation and groundbreaking observations of the solar interior from space using the NASA/ESA Solar and Heliospheric Observatory (SOHO).

As these and other results about our world and the universe pour in, NASA also continues to develop and launch our next generation of missions, and to support a vigorous scientific community via research and data analysis funding. In total, NASA currently is developing or flying a total of 93 space and Earth science missions--far more than all of the other space agencies of the world combined. The Agency also supports over 3,000 separate research investigations in its science Research and Analysis programs, spending a total of approximately $600 million annually on scientific data analysis, modeling, and theory across the four disciplines of Earth and space science. Undergraduate and graduate students are active participants in these efforts.

Conclusion

We must encourage every segment of our population -- girls and boys alike -- from every walk of life, of every color and creed, to reach out and prepare for the opportunities of the 21st century. Building a pipeline of science and engineering talent to serve in the coming decades as we implement the Vision for Space Exploration to continue America's pre-eminence in space and aeronautics research and development can and must be done. NASA's mission is one of dreams, vision and exploration – characteristics that are ingrained in the American spirit and the underpinning of innovation and economic competitiveness. We intend to continue turning heads across the world by developing space missions and supporting scientific research that rewrites textbooks in all of our science disciplines, thus inspiring the next generation of students.

Again, thank you for the opportunity to testify today. I would be pleased to respond to any questions you or the other Members of the Subcommittee may have.