

**Remarks as delivered by The Honorable Shana Dale  
NASA Deputy Administrator  
Chicago Future Forum  
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Thank you very much.

As some of you may know, this is the final Future Forum in celebration of NASA's 50th Anniversary. What a fine city to hold the 7<sup>th</sup> and final event -- beautiful weather, a stunning venue, and impressive experts. It should be a great day.

I know there has been much hard work and effort put into these events, and I would like to take a moment to recognize the NASA team for making them become reality. Special thanks go to NASA's Office of Communications Planning, who coordinated and managed all the Forums, along with the great support of the Office of Public Affairs, the Office of Education, the NASA Mission Directorates, and the NASA Centers. I would also like to thank Dr. Paul Knappenberger and the Adler Planetarium for being such wonderful hosts, and thank our sponsors and key partners for helping to make this event possible.

It is an honor to be here at the Adler Planetarium, known as "America's First Planetarium." Both the Adler Planetarium and NASA seek to inspire and educate future explorers, but there is another tie between the two as well. The architect of this beautiful building was Ernest Grunsfeld, and his grandson, Dr. John Grunsfeld, is scheduled to fly aboard the Space Shuttle Atlantis as part of the STS-125 Hubble Space Telescope Servicing Mission in 2009. This 11-day mission will mark the fifth and final servicing of the remarkable Hubble Space Telescope. John is a Chicago native and an Adler Astro Science Workshop alumnus. STS-125 will be his third trip to Hubble. And he will be traveling with another Illinois native, Scott Altman, who will command the Hubble mission. Scott's hometown is Pekin, and this will be his second trip to Hubble.

Illinois has a long history of supporting inspiration, innovation, and discovery. In 1893, Chicago's World's Fair, known as The World's Columbian Exposition, was held in celebration of the 400<sup>th</sup> anniversary of Columbus discovering the New World. Forty years later, in 1933, Chicago hosted another World's Fair, called a "Century of Progress" where the world celebrated the 100<sup>th</sup> anniversary of Chicago and celebrated scientific discoveries of that time. The Adler Planetarium played an innovative role in that World's Fair. On opening night, astronomers at the landmark planetarium used a new technology -- photocells -- to convert light from the distant star, Arcturus, into electric current. The light from Arcturus was concentrated through a telescope lens and then shone onto the photo cell. The resulting electronic signal was then used to trigger the switch that turned on the lights at the World's Fair.

Today, the Adler Planetarium is helping celebrate NASA's 50 years of scientific discoveries and what these discoveries have meant to Chicago, to Illinois, and to the world. NASA's mission is to explore, and we meet our mission through inspiration, innovation, and discovery. During the last five decades, we've made amazing achievements in space; we've seen complete hurricanes for the first time; we've stepped on to the surface of the Moon; and we've seen to the far reaches of the universe. We've discovered evidence of dark matter and

dark energy, and with that, realized that we have seen only a tiny fraction of what is actually out there.

Yet, there is another side of NASA – a critical part of our story, which does not often receive the accolades or attention given to our exciting missions and discoveries. This other side of NASA contributes to what we call the “Space Economy” – the very tangible and pervasive ways in which the exploration of space affects our daily lives here on Earth. The Space Economy is the full range of activities that create and provide value to human beings in the course of exploring, understanding and utilizing space. Space is pervasive in our lives, invisible, yet critical to so many aspects of our daily activities and well-being. In fact, the Space Economy impacts just about every aspect of how we live, work and play – from weather and climate monitoring to space-based security applications that keep us safe. When we use our GPS units to keep us from getting lost, withdraw cash from an ATM, or listen to satellite radio, we experience the benefits of the Space Economy. Today’s Future Forum is about how NASA and the Space Economy contribute to *your* community.

Space exploration has created new markets and new technologies that have spurred our economy and changed our lives in many ways. According to a 2008 U.S. Space Foundation report, the Space Economy generated more than \$251 billion in total revenues worldwide, up 11 percent from the previous year.

So what does this have to do with NASA? Our mission is not to create commercial products or to stimulate the economy, although our work has often had those effects. Our focus is not on healthcare or medical research for the general public, yet we have made significant contributions in those areas. We are not the Nation’s environmental agency, yet we provide critical information that advances environmental understanding. The simple answer is that exploration of space demands that we push the limits of knowledge, science, and technology in ways that we could not have originally imagined – and the benefits go far beyond our space exploration mission. NASA contributes to the Space Economy through the three principal topics we will discuss today: Inspiration, Innovation and Discovery.

Let’s face it. It all begins with education, and because space exploration is so exciting and so cool, it inspires kids to go into science, engineering and math. Generations of students have been inspired to pursue these studies for a glimpse into the mysteries of our universe. Over the last 50 years, many of these students have gone on to power every form of innovation from advancing the development of the computer chip to mapping the human genome.

Maintaining our Nation’s leadership role in the global economy requires that we encourage more American students to focus on these fields. Using the inspirational pursuit of space exploration to spark the imagination of our youth is critical for keeping this Nation competitive and creating a scientifically literate populace. I look forward to a solid discussion today on how best to inspire the next generation of innovators and scientists.

Inspiration leads directly to innovation. NASA *drives innovation* by tackling hard, complex problems, and by overcoming seemingly insurmountable obstacles. Because our mission demands putting humans, robots and rovers into harsh, extreme, and unforgiving environments, we must push the very limits of technology. This is often where we realize the greatest innovations.

Here is an example we can all relate to – going to the dentist. For some, thoughts of sitting in a dentist’s chair are not always pleasant, especially when patients’ gums are being probed to check for periodontal disease. Today, however, with the help of NASA technology, that probing just got a little easier and a lot less painful. Periodontal disease is the most common dental disease, and sometimes it even becomes life threatening. So, how does NASA technology help? The answer is an adapted ultrasound technology.

When determining the cause of a wind tunnel accident in the 1970s, an investigation panel and a young NASA physicist, Dr. Joseph Heyman, found that the failure was due to improperly tightened bolts. As a solution, Dr. Heyman developed an ultrasonic device that would measure bolt elongation, as opposed to torque. This allowed NASA to assess the condition of the entire bolt as opposed to just measuring how tight it was. Over the years, the technology has been applied to everything from increasing mine shaft safety to measuring the intracranial pressure of astronauts. It has even been adapted for dental applications.

The resulting dental technology is the Ultrasonographic Probe, or US Probe, patented by Visual Programs Inc., of Richmond, Virginia. With less pain and more accuracy, the US Probe is able to do what manual probing did before. The tool is able to detect and characterize periodontal disease through echoes from signals sent along the gum lines, which are then analyzed and charted by a computer. This is a technology that we refer to as a “spinoff” – a specific technology the agency has developed for its missions that the private sector then picks up and refines or transforms for commercial use.

While this technology is not a highly visible achievement of America’s space program, it is important. It demonstrates how we push through the boundaries of knowledge to accomplish airspace and aeronautics missions -- creating technologies for NASA that are then transformed by American entrepreneurs. Dr. Heyman created a device as a result of a wind tunnel accident, and it’s now being used to increase mine shaft safety and detect periodontal disease. Who could have imagined that? But it happens all the time because of NASA, and it represents only one of over 1,600 documented NASA-derived technologies that fuel local economies and strengthen U.S. economic competitiveness.

Another example – most of you have flown sometime in your life, and some of you are frequent flyers. In an effort to help air traffic control centers improve the safety and efficiency of the National Airspace System, NASA Ames Research Center in California developed software known as the Future Air Traffic Management Concepts Evaluation Tool, or “FACET.” This tool can quickly produce thousands of aircraft trajectories through modeling and simulation capabilities. This can help to streamline the flow of air traffic across the entire National Airspace System. This software won NASA’s 2006 “Software of the Year” competition and is part of NASA’s Airspace Systems Program. In 2005, Ames licensed Flight Explorer Inc., to use this software to alert airspace users to potential demand and capacity imbalances. This helps dispatchers be prepared for congested airspace and delays and make decisions on rerouting planes. According to the FACET developers, the information provided allows airspace users to develop enhanced flight-routing strategies that save fuel, preserve airline schedules, and reduce passenger delays and missed connections. This is an example of a NASA technology used by industry to help with a problem here on Earth that is only increasing over time.

NASA-derived technologies are also directly improving the living conditions of people in the developing world. The water recycling and filtration systems engineered to sustain

astronauts living on the International Space Station have been adapted to provide safe, affordable drinking water in poor or remote regions of the world where clean water can mean the difference between life and death.

These are only a few examples of what NASA technologies mean for all of us here on Earth, but it is by no means an exhaustive list. The point is that technology advancement doesn't recognize boundaries. The same capabilities that apply "out there" in space also apply directly to our most critical needs back here on Earth. Those advances are then refined, adapted, or transformed to meet the challenges we face from making dental visits less painful and more accurate to streamlining airplane traffic in the U.S. to providing clean drinking water. And NASA's investments driving these innovations -- are happening on a budget with a funding level that is less than sixth-tenths of one percent of the Federal budget.

These contributions also benefit Chicago and the State of Illinois. In FY 2007, NASA obligated over \$26 million in the state. This funding went to business, education, and non-profit institutions. Illinois companies are also helping in the Constellation program -- the program that will enable us to return to the Moon and then go to Mars and beyond. For example, companies supporting work on the Ares I Launch Vehicle in Illinois include Cain Tubular Products Inc. of St. Charles, Hamilton Sundstrand Space Systems International of Rockford, Scot Inc. of Downers Grove, Smalley Steel Ring Company of Lake Zurich, Snap-On Industrial of Crystal Lake, and The Caldwell Group of Rockford. The Boeing Company, headquartered in Chicago, is performing technology development on one of the material options for the Orion Thermal Protection System and is the production contractor for the Ares I Upper Stage and Instrument Unit.

Did I mention that NASA's investments are happening on a budget with a funding level that is less than six-tenths of one percent of the Federal budget. And what a sweet return on investment that is for the American taxpayer. With this budget, we invest in and accomplish amazing missions -- I'm just going to highlight a few of them:

- (1) Embarking on the human journey back to the Moon for a mission that is vastly different from Apollo. About twelve years from now, we'll live on the surface of that world, and learn enough to take the next steps out into our solar system.
- (2) Using NASA satellites to observe remarkable changes in the environment such as the rise of global sea level, the depletion of sea ice and glaciers, and the increase in transcontinental transports of air pollution.
- (3) Conducting fundamental research in aeronautics that will lead to quieter, safer, and more efficient airplanes.
- (4) Expanding our knowledge about the universe and our place in it, through projects like the Hubble Space Telescope.
- (5) And leading the largest international cooperative endeavor in the history of science and technology -- the International Space Station.

All of these missions and many more -- all of the inspiration that makes kids want to study science, technology, engineering and math -- all of the work to push the limits of technology

leading to some of the world's greatest innovations, innovations that spur the growth of the US economy – all this for sixth-tenths of one percent of the Federal budget.

And then there is discovery. From innovation, NASA opens the door to new discoveries. NASA's pursuit of *discovery* pushes the extremes of science to answer fundamental questions, to achieve a greater understanding of the universe, and to determine what is happening to the Earth's climate and why.

In space exploration, we are in an exciting new age of discovery, going to the Moon, Mars, and beyond. In cooperation with our international partners, we'll construct an outpost there, a sustained human presence on the Moon. NASA is pursuing discoveries that will enable us to accomplish this endeavor. To survive on the Moon's surface, we must find ways to create, collect, store and use energy without access to fossil fuels. Other sources of energy must be developed into practical resources that humans can use in extreme environments.

As we continue to explore new sources of energy and new delivery methods, these efforts can help to address the pressing demand for energy right here on Earth. Space exploration demands cleaner and more efficient sources of energy that can operate in extreme environments without toxic effects. The potential impact of alternative, clean energy sources is so great, that we can hardly imagine it, affecting the lives of not only Americans, but of every person on the planet.

That's what will happen in the future, but what is happening now? How is NASA's work, right now, contributing to the sustainability of our planet?

In space travel, physical space is limited, weight is critical, and resources are severely constrained. Every watt of energy is accounted for and every resource is transported and monitored. Space exploration drives the development of technologies with minimal impact to these tiny ecologies and, by extension, to the ecology of Planet Earth.

These technologies include advanced recycling techniques – treating waste and converting it back into usable resources, as well as new, green power systems. But, perhaps NASA's biggest contribution to sustainability is improved understanding of the global integrated Earth system through observations from a constellation of fifteen Earth-observing satellites and cutting-edge global models.

NASA satellites record more global climate change data than those of any other organization in the world. It is only through NASA's investments in measuring the forces and effects of climate change that we have insights into the future conditions of Earth's changing environment and understand its implications to our home planet.

In September 2007, NASA scientists observed the smallest Arctic sea ice coverage ever recorded, and this effect is accelerating. The sea ice coverage in September 2007 was smaller than in September 2006 by an area that exceeded the combined geographical areas of California and Texas. Based on NASA satellite data, we see the ice sheets of Greenland and Antarctica melting more rapidly than predicted. For each of the past four years, the amount of ice in Greenland has decreased by more than twice the amount of ice in the European Alps. This huge amount of ice is melting and flowing into the ocean.

Using NASA satellites, we have recorded rising global sea levels in excess of 3.2 millimeters per year over the past fifteen years.

In regards to nitrogen oxide emissions, one of the greenhouse gases that form smog, NASA satellites helped researchers document their doubling in Asia from 2000 to 2006. This incredibly important climate data is discovered through NASA's fifteen Earth-observing satellites in orbit today. We have another six Earth Science missions in development, three of which will launch over the next 20 months.

In addition, this year we initiated formulation and concept study activities for four Decadal Survey missions, expected to lead to the first satellite launch in this new program as early as 2013. All in all, NASA invests approximately \$1.3 billion every year in Earth Science. As we continue to explore, we're making new discoveries along the way that are helping our planet.

Inspiration, innovation and discovery: each is interdependent and through a circle of renewal, they combine to create a formula for future growth, prosperity and an improved quality of life. This symbiotic relationship forms the essence of the Space Economy and it is through inspiration, innovation, and discovery that NASA makes its most fundamental contributions to life here on Earth.

Space exploration is about imagining the future. It's about taking new steps, exploring beyond our limitations, and creating something bigger and better than ourselves. Along the way, there are countless benefits, invaluable discoveries and technologies borne through the trials of exploration that enhance our lives on Earth.

That's been true for NASA's first fifty years. I have no doubt that it will be true for the next 50 years. Quests of discovery are as old as humanity itself. We go to see what is beyond the horizon, to test ourselves against the unknown, to face our fears and overcome challenges using all of our ingenuity and determination. That's the spirit of exploration and that's why the space program shows us at our best. Dreaming, daring, and achieving.

I look forward to a day of discussion about the future -- a future brightened by the prospect of a growing Space Economy and bold, new space exploration and all the promise that holds for the people of Chicago, for our Nation and for our world.

Thank you.