



Office of the Chief Technologist Update

NASA Advisory Council

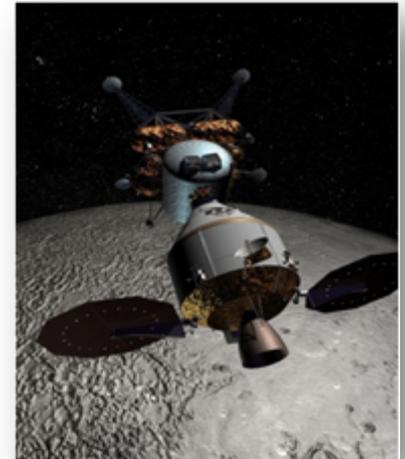
Dr. Mason Peck
NASA Chief Technologist
November 15, 2012



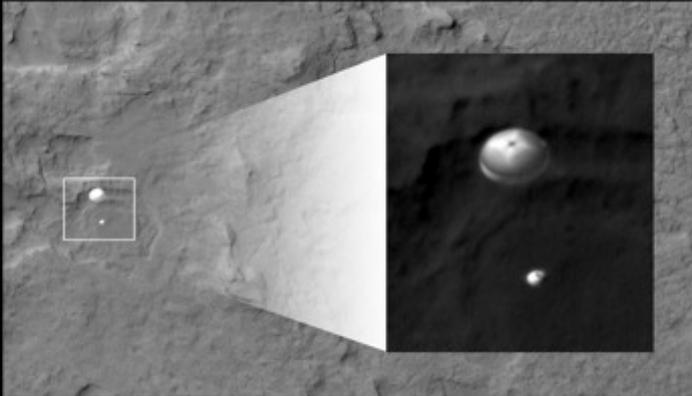
Technology Transforms Science and Exploration



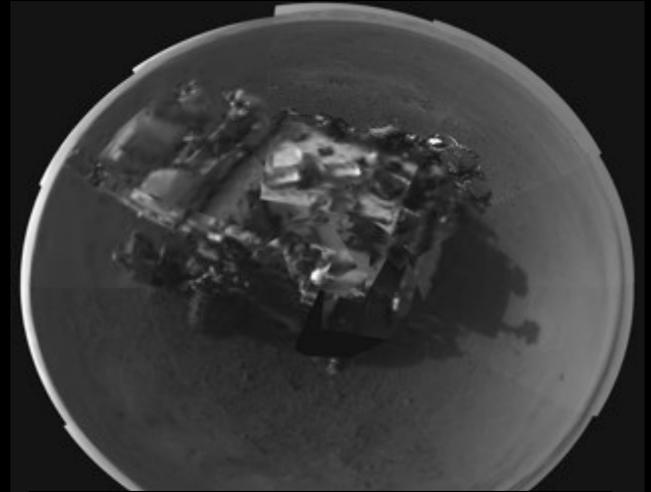
- Technology can transform our way of thinking about space science and exploration:
 - Providing capabilities fundamental to the Agency's direction and the U.S. space enterprise
 - Enabling the next generation of scientific, robotic, and human exploration missions through aggressive and prioritized technology investments
 - Seeking transformative opportunities through technology innovations from other parts of the economy
 - Maintaining an Agency space technology base to enable future missions



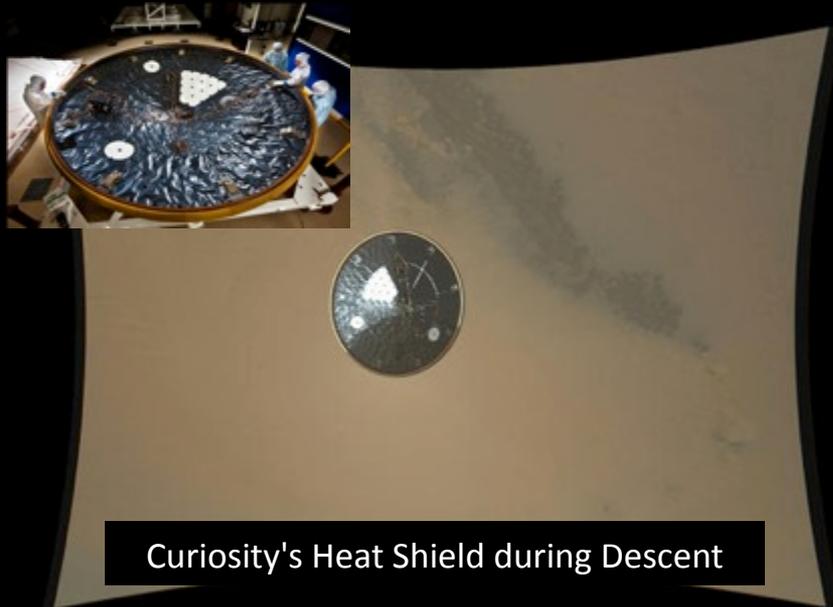
Technology Success: One of Many on Mars



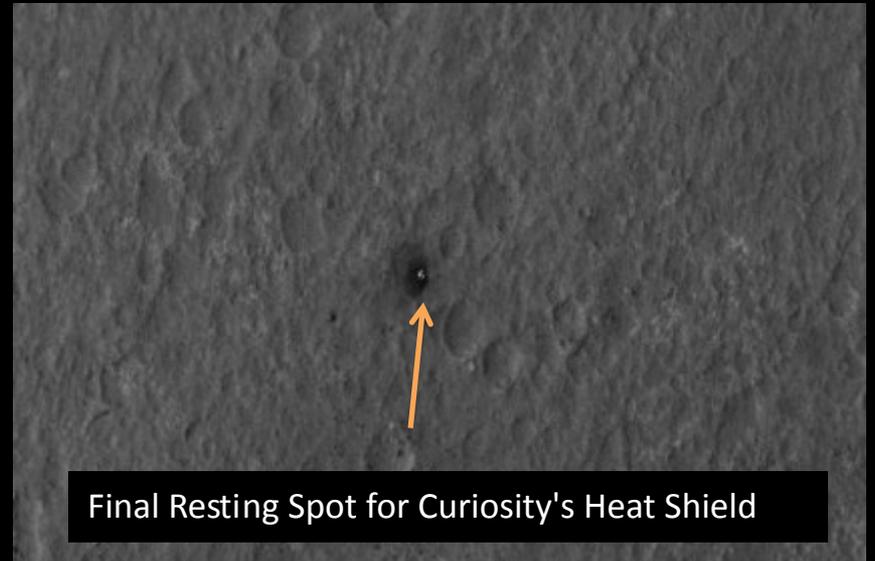
Curiosity with chutes deployed during descent to Mars Surface



Curiosity's Self Portrait on Mars

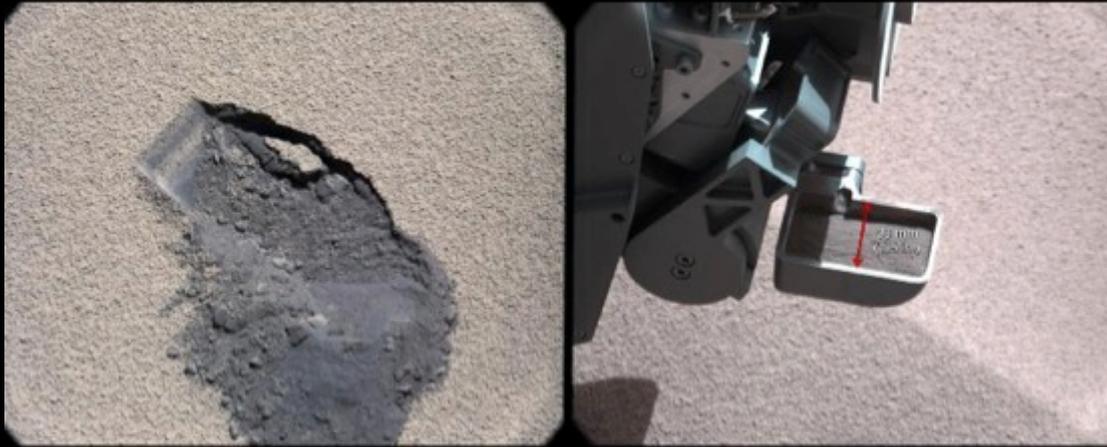


Curiosity's Heat Shield during Descent

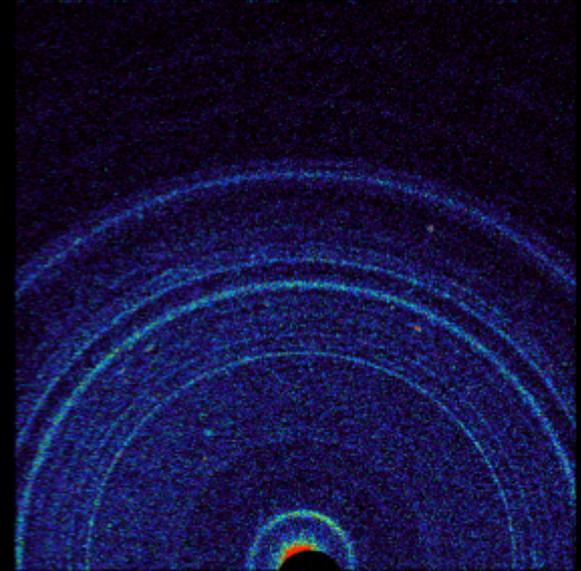


Final Resting Spot for Curiosity's Heat Shield

Technology and Science Powering Curiosity



This pair of images shows a "bite mark" where NASA's Curiosity rover scooped up some Martian soil (left), and the scoop carrying soil.



This graphic shows results of the first analysis of Martian soil by the Chemistry and Mineralogy (CheMin) experiment on NASA's Curiosity rover.

Technology: Stepping Stones to the Future



“Half or more of the growth in the nation’s gross domestic product in recent decades has been attributable to progress in technological innovation”

- NRC, Rising Above the Gathering Storm, Revisited

- **NASA must, through the development of technology**
 - Provide capabilities fundamental to the Agency’s direction and U.S. space enterprise
 - Transform the path for space science and exploration
 - Enhance national innovation and economic growth



Technology: Stepping Stones to the Future



“Half or more of the growth in the nation’s gross domestic product in recent decades has been attributable to progress in technological innovation”

- NRC, Rising Above the Gathering Storm, Revisited

- **NASA technology development addresses National priorities**
 - Directs NASA to work with industry, academia and international partners to implement new space technology development
 - Encourages growth of U.S. commercial space sector
 - Maintain a space technology base that aligns mission directorate investments, increases capability, lowers mission cost and supports long term needs
 - Directs aggressive and prioritized technology investments to supports robotic and human exploration missions



Office of the Chief Technologist



Serves as Advisor to Administration



Direct Technology Management and Budget Authority for the Space Technology Program

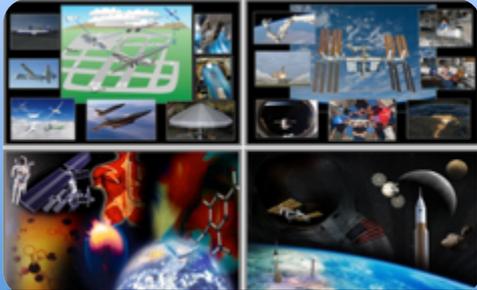
Office of the Chief Technologist



Demonstrates and Communicates Societal Impacts of NASA Technology Investments



Advocates Externally NASA's R&D Programs



Integrates Technology Investment Across the Agency



Leads Tech Transfer, Partnerships and Commercialization Activities Across the Agency

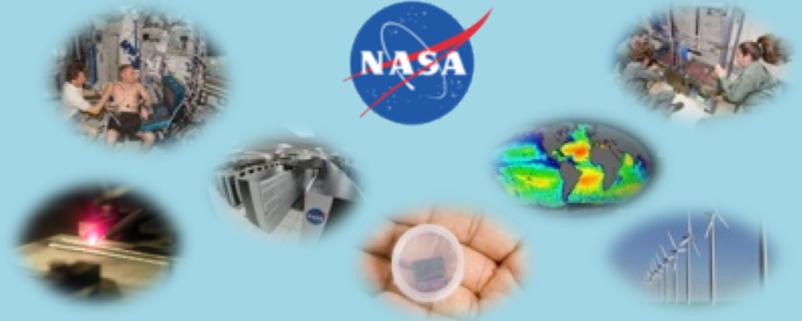
National Science and Technology Priorities for FY 2014

Scientific discovery, technological breakthroughs, and innovation are the primary engines for expanding the frontiers of human knowledge and are vital for responding to the challenges and opportunities of the 21st century.



Administration's Multi-Agency Priorities (OSTP):

- **Resource sharing and cooperation** among multiple Federal Agencies for success
- Identify and Pursue **"Grand Challenges"** that require advances in science, technology and innovation to achieve
- **Support the research tools and infrastructure** needed to ensure that U.S. remains at the leading edge
- **Strategic prioritization of resources** to key science and technology activities
- **Promote Innovation and Commercialization** from Federal R&D investments
- **Promote Science, Technology, Engineering, and Mathematics (STEM) Education** where Federal government can have maximum impact
- **Key Focus Areas**
 - Advanced Manufacturing
 - Clean Energy
 - Global Climate Change
 - Information Technology Research and Development
 - Nanotechnology
 - Biological Innovation



NASA's Office of the Chief Technologist (OCT) is responsible for direct management of NASA's Space Technology programs and for coordination and tracking of all technology investments across the agency. The responsibility is shared across the agency.

- **Across NASA's Space Technology Programs**
 - Early Stage Innovation
 - Crosscutting Capabilities
 - Game Changing Technology
- **Across NASA's Mission Directorates and Offices**
 - Aeronautics Research
 - Human Exploration and Operations
 - Science
 - Office of the Chief Scientist
 - Office of the Chief Engineer
- **Partnerships with other government agencies, US industry, and internationals**

NASA Technology is Aligned with the Nation's Priorities

NASA's Technology Portfolio



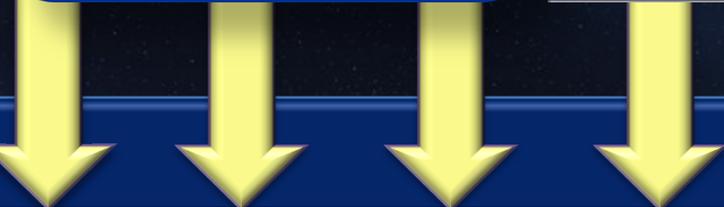
National Science and Technology Priorities



Top Down Driven Strategic Guidance

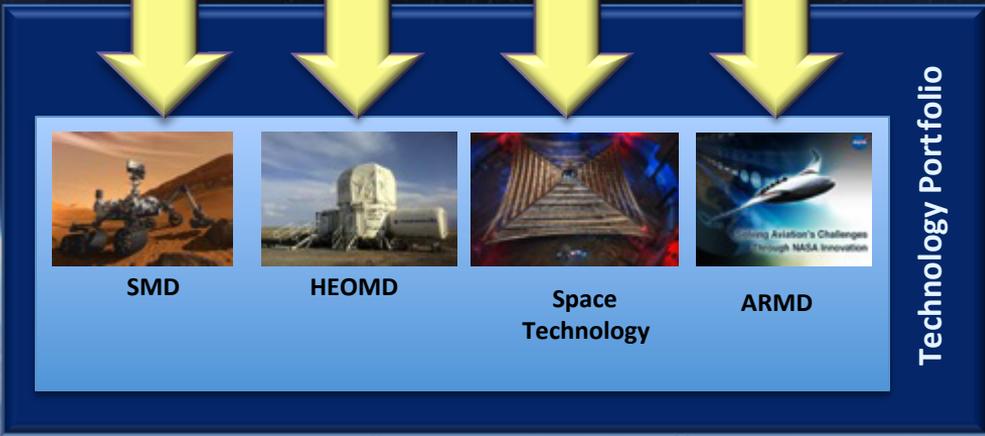


National Aeronautics Research and Development Plan



External Technology Portfolio & Partnerships

Mission Directorate Requirements



Technology Portfolio



Bottom Up Driven Requirements

NASA's Space Technology Portfolio



2010

Space Technology Roadmaps

- 140 challenges (10 per roadmap)
- 320 technologies
- 20-year horizon

- Revised every 4 years



2011

National Research Council (NRC) Study

Prioritization:

- 100 top technical challenges
- 83 high-priority technologies (roadmap-specific)
- 16 highest of high technologies (looking across all roadmaps)

- Requested every 4 years



2012

SSTIP

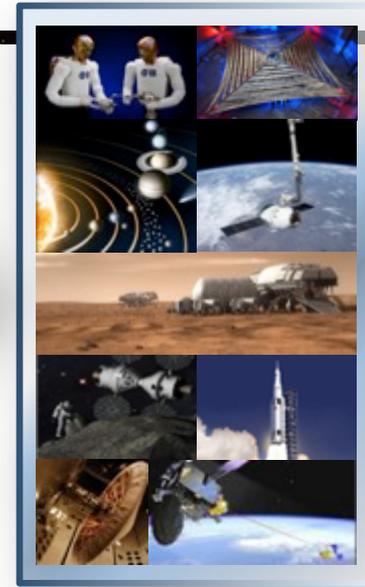
Updated ST Roadmaps:

- Incorporate NRC Study Results

Developing a Strategic Space Technology Investment Plan:

- current investments
- current MD/Office priorities
- opportunities for partnership
- gaps vs. current budget and capabilities
- 20-Year horizon with 4-year implementation cadence

- Revised every 2 years



Execution

Investment Portfolio

- Technology Developments (across full Technology Readiness Level (TRL) spectrum)
- Flight Demonstrations
- Must accommodate:
 - Mission Needs
 - Push Opportunities
 - Affordability
 - Technical Progress
 - Programmatic Performance
 - Commitments

- Budgeted annually

Strategic Space Technology Investment Plan (SSTIP) Summary



- 20-year horizon, investment guidance for the next four years
- Framework:
 - Goals
 - Capability Objectives
 - Technical Challenges
- Four-year investment approach
 - 70% - 8 Core technologies represent 12 of 16 NRC top priority recommendations
 - 20% - Adjacent Technologies: Not part of the Core but are part of the NRC's 83 high priorities
 - 10% - Seeding Innovation: Smaller Investments in remaining technologies in the roadmaps that were not part of the NRC's 83 high priorities.



Innovative Partnerships Office (IPO) Programmatic Elements



Technology Transfer: Agency-level management and oversight of intellectual assets, including transfer of NASA-developed and owned intellectual property to outside entities. Includes new invention capture, intellectual property management, licensing activities, technology transfer-focused partnerships, and programmatic reporting/tracking.

Strategic Partnerships: Partnerships to expand and strength NASA's ability to excute its mission, ranging from non-traditional partnerships to systematic engagements with regional, state, and local partners that accelerate technology transfer and commercialization in support of regional economic innovation and growth.

Prizes and Competitions: Agency-level leadership and coordination of the use of prizes and competitions to spur innovation, diversify pool of solvers addressing NASA problems, advance technology development in a flexible, "on-demand" way, and lower mission design costs to leverage government dollars for technological breakthroughs.

Emerging Space Office: Managed out of ARC, and principally a consultative office, examining the role of the government in support of the emerging space industry.

Prizes Have a Long Track Record of Spurring Innovation



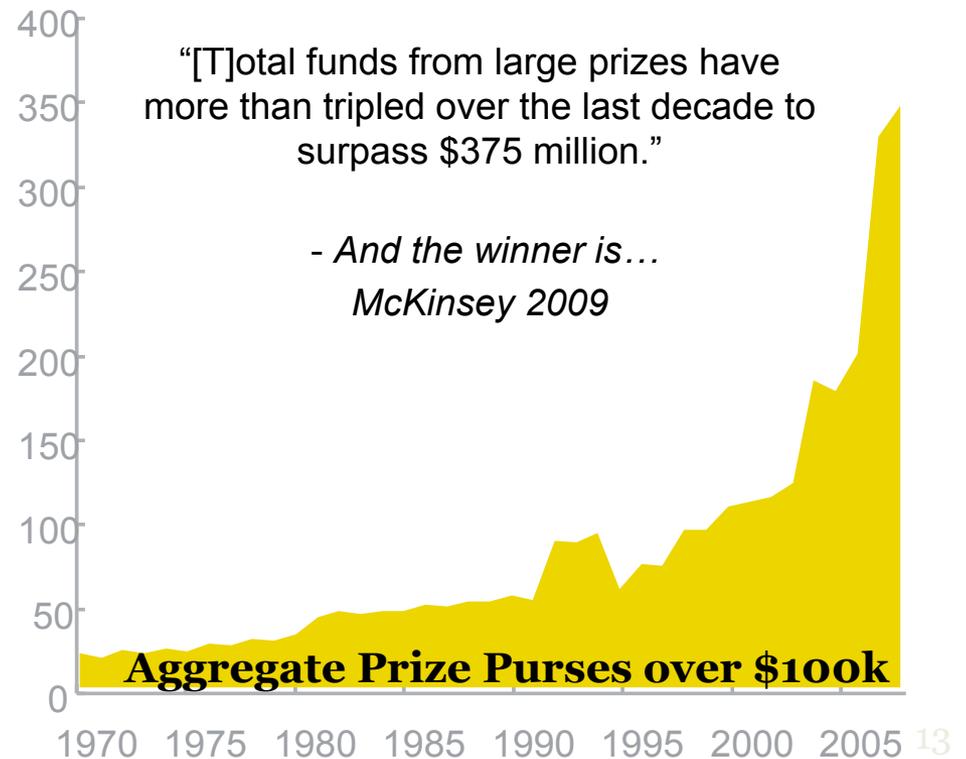
- 1919 Orteig Prize
- Charles Lindbergh: Non-Stop Flight NY-Paris

“The Federal government should ... use high-risk, high-reward policy tools such as prizes and challenges to solve tough problems.”

*-President Barack Obama
August 5, 2009*

“[T]otal funds from large prizes have more than tripled over the last decade to surpass \$375 million.”

*- And the winner is...
McKinsey 2009*





NASA's Track Record with Prize Success

- The results of many of NASA's prize competitions have started to illustrate the value of this tool to NASA.

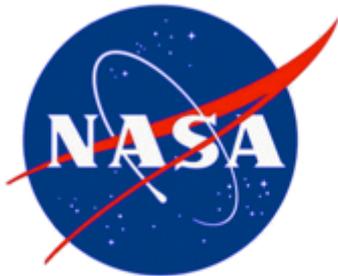
Observed Value	Case Study
Results from Unexpected Places	A challenge to forecast an algorithm to protect America's astronauts from radiation exposure in space was won by a retired radio-frequency engineer in rural New Hampshire to an 85% accuracy.
Results, Quickly	A data-mining competition to map "dark matter" was solved in under a week. The solution outperformed the state-of-the-art algorithms most commonly used in astronomy for mapping dark matter.
Leveraging Government Dollars for Technology Breakthroughs	NASA's \$1.65 M Green Flight Challenge to build and demonstrate a super-fuel efficient full-scale aircraft leveraged taxpayer dollars by stimulating an additional \$7 M in investment. Two winning teams exceeded the performance requirements by nearly a factor of two, flying more than 200 miles on the energy equivalent of just half a gallon of gas, all while averaging 100 mph with two people on board.

NASA Rewards Innovation



- NASA is the leader in the Federal Government in prize competitions.
- Prizes are particularly suited for makers' invention, creativity and resourcefulness.
- Create never-before-seen technologies, win money, learn about space tech, and get involved in the exciting challenges of space exploration!

PRIZES BY



CENTENNIAL
CHALLENGES



Masten Space Systems



Peter K. Homer, Maine

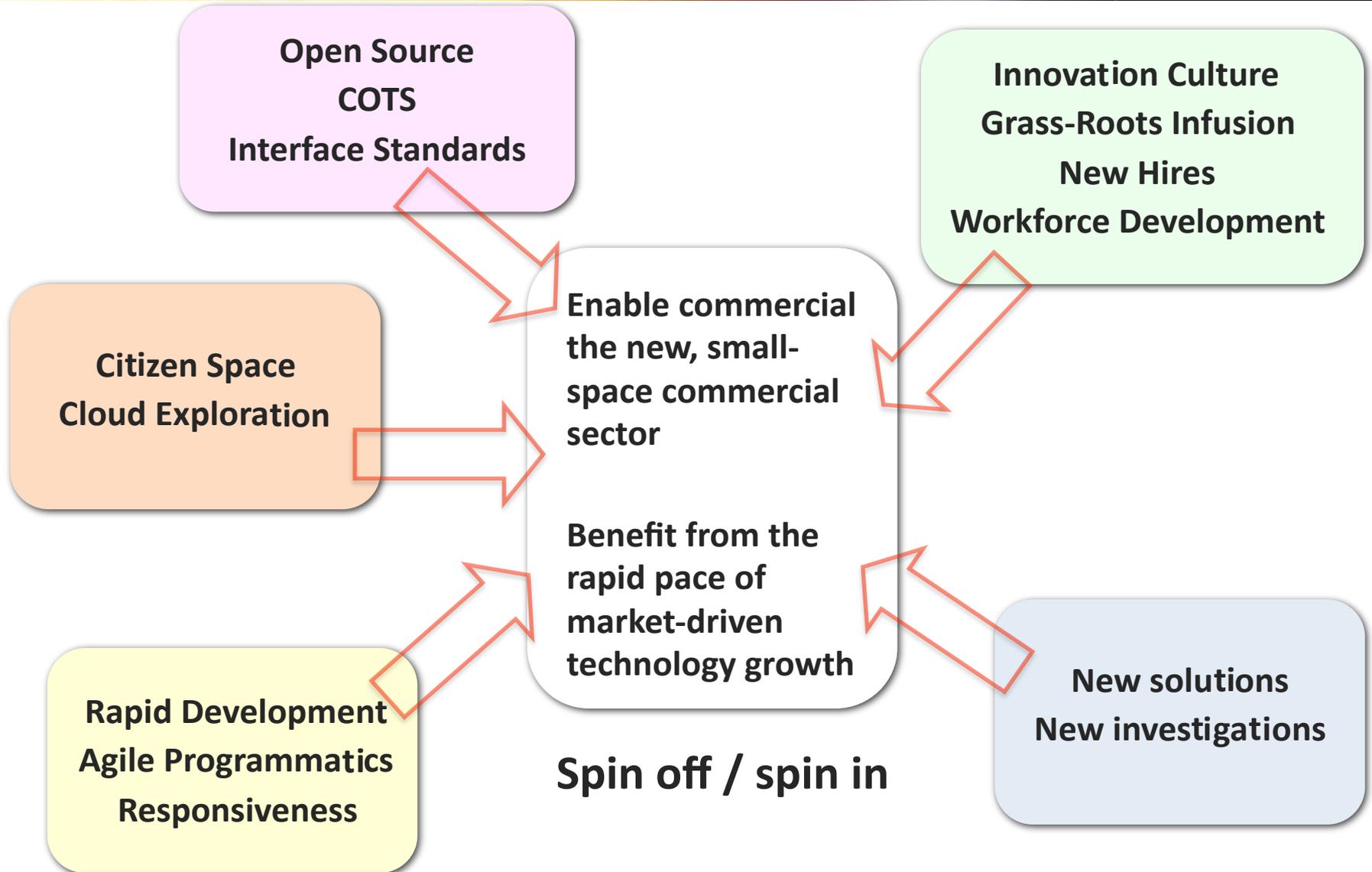
Citizen Space



- Makers are already taking the development of space technology into their own hands.
- CubeSat: a low-cost, hacker-friendly spacecraft standard
 - Standard interface and form factor for small spacecraft : COTS parts, Arduino-friendly
 - Developed independent of government work at Stanford and Cal Poly
 - Now one of the most commonly built types of spacecraft in the world.
- NASA has followed the lead of citizen innovators
 - Embraced the standard
 - Created a new launch program: over 50 US university CubeSats are manifested to be launched for free through NASA



Why Small Spacecraft at NASA?



Citizen Space



- Another great example is the success of spacecraft crowd-funded on Kickstarter: several different American DIY spacecraft efforts have raised more than their goal, some over \$100k.

What is Kickstarter? We're the world's largest funding platform for creative projects. [Learn more!](#)

KICKSTARTER Discover great projects Start your project

KickSat -- Your personal spacecraft in space!
An Open Hardware project in Ithaca, NY by Zachary Manchester · [send message](#)

PROJECT HOME UPDATES 11 BACKERS 202 COMMENTS 23



315
BACKERS
\$74,586
PLEGGED OF \$30,000 GOAL
0
SECONDS TO GO

FUNDING SUCCESSFUL
This project successfully raised its funding goal on December 3, 2011.

PLEDGE \$25 OR MORE
67 BACKERS
Your name on one of KickSats panels that will fly into space

PLEDGE \$75 OR MORE
67 BACKERS
All of the above, plus a replica Sprite spacecraft of your own as a souvenir

ABOUT THIS PROJECT

Would you like to have your own spacecraft in space?

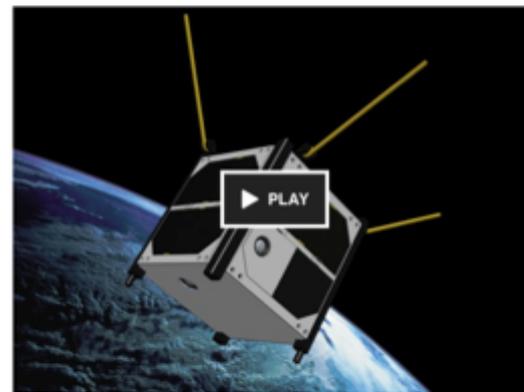
I'm Zac Manchester, a graduate student in Aerospace Engineering at Cornell University. Over the last several years a few collaborators and I have designed, built, and tested a very tiny and inexpensive spacecraft called Sprite that can be built and launched into low Earth orbit for just a few hundred dollars each!

What is Kickstarter? We're the world's largest funding platform for creative projects. [Learn more!](#)

KICKSTARTER Discover great projects Start your project

ArduSat - Your Arduino Experiment in Space
An Open Hardware project in San Jose, CA by ppl4world · [send message](#)

PROJECT HOME UPDATES 6 BACKERS 527 COMMENTS 4



527
BACKERS
\$82,083
PLEGGED OF \$35,000 GOAL
4
DAYS TO GO

THIS PROJECT WILL BE FUNDED ON SUNDAY JUL 15, 1:42AM EDT.

BACK THIS PROJECT
\$1 MINIMUM PLEDGE

PLEDGE \$1 OR MORE
102 BACKERS

Every dollar helps! With any donation, you can join the discussions on the comment page and the backers list on our website. Furthermore, you have our personal gratitude, and we'll prove it to you with a personal thank-you email.

ABOUT THIS PROJECT

UPDATE: New target is a double sized ArduSat with better camera and sensors for \$ 75,000 or even two singles sized ArduSats for Satellite-to-Satellite communication experiments. So join us now!

UPDATE: We've posted a bunch of ideas for ArduSat apps on our [ideas page!](#)



NASA's CubeSat Launch initiative (CSLI)

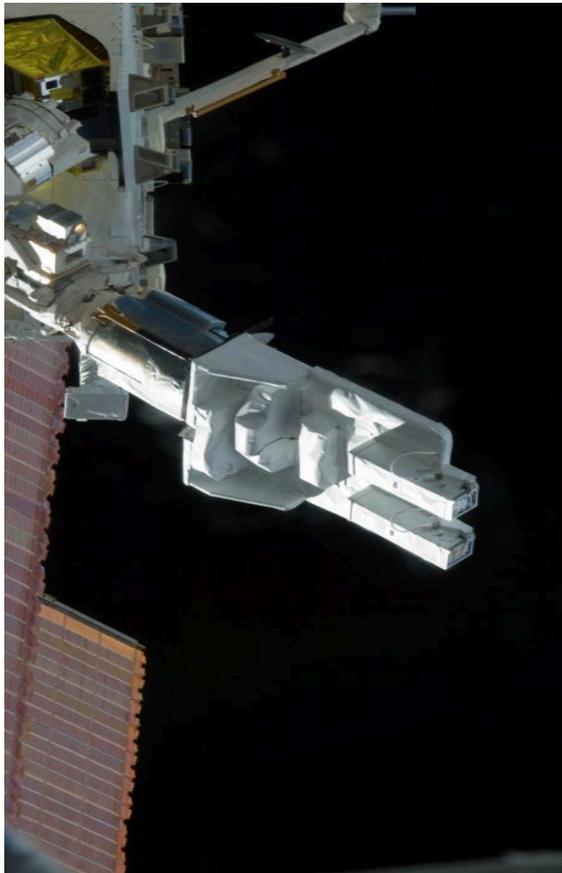
- NASA's CubeSat Launch initiative (CSLI) provides opportunities for small satellite payloads to fly on rockets planned for upcoming launches. These CubeSats are flown as auxiliary payloads on previously planned missions
- CSLI promotes and develops innovative technology partnerships among NASA, U.S. industry, and other sectors for the benefit of Agency programs and projects.
- NASA has selected 33 small satellites to fly as auxiliary payloads aboard rockets planned to launch in 2013 and 2014.
- 32 CubeSat missions have been selected for launch in the previous two rounds of the CubeSat Launch Initiative. Eight CubeSat missions have been launched (including five selected via the CubeSat Launch Initiative) to date via the agency's Launch Services Program Educational Launch of Nanosatellites, or ELaNa, program
- More information can be found at http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html



TechEdSat Deployment from ISS



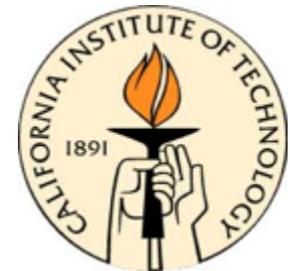
- Oct 4, 2012: Demonstration of the JAXA J-SSOD on board the ISS for deployment of CubeSats



TechEdSAT Video



Engaging Universities



Space Technology: Investments in Our Future



- **Enabling Our Future in Space:** By investing in high payoff, disruptive technology that industry cannot tackle today, *Space Technology* matures the technology required for NASA's future missions in science and exploration while proving the capabilities and lowering the cost for other government agencies and commercial space activities.
- **NASA at the Cutting Edge:** Pushing the boundaries of aerospace technology and seizing opportunities, *Space Technology* allows NASA and our Nation to remain at the cutting edge.





NASA Technology Days

Cleveland, Ohio

November 28-30, 2012

Join NASA, the NIA, and AIAA for this three-day event and technology showcase. It will bring together a broad community of stakeholders from industry, academia, and the U.S. federal government to engage in strategy development, partnership building, and implementation of ways to foster technology transfer and innovation.

- Get a comprehensive overview of NASA's technology programs for space exploration and aeronautics, and discover innovative and advanced technologies that are stimulating the economy and sustaining our nation's global competitiveness
- Learn about the Space Technology Program objectives, successes, and plans for the future
- Get an in-depth overview of NASA's potential industry partnerships and opportunities
- Discuss Agency-wide technology transfer and commercialization efforts
- Engage with program managers and network with peers on potential collaborative enterprises
- Explore mature NASA technologies primed for commercialization in the aerospace, advanced energy, automotive, manufacturing and biomedical sectors
- Participate in the technology showcase featuring mature technologies in the fields of *Aerospace, Advanced Energy, Innovative Manufacturing, Human Health, and Automotive*. The demonstrations and displays will provide attendees opportunities for networking, business development and forging new partnerships, while learning about the leading technologies contributing to American economic growth and innovation

NASA Technology Days



National Aeronautics and Space Administration

NASA

TECHNOLOGY DAYS

NOVEMBER 28-30, 2012

PUBLIC AUDITORIUM
CLEVELAND, OH

Come join NASA for "Technology Days" in Cleveland, OH, November 28-30, 2012.

Engage NASA leaders about the Space Technology Program's objectives, successes and future plans. This 3-day event and technology showcase will bring together a broad community of stakeholders from industry, academia, and the U.S. government to engage in strategy development, partnership building, and implementation of ways to foster technology transfer and innovation.

Registration is now open!

For more information visit www.aiaa.org/NASATechDays

AEROSPACE

ADVANCED ENERGY

AUTOMOTIVE

INNOVATIVE MANUFACTURING

HUMAN HEALTH

**NASA Technology Days
November 28-30, 2012**

**Register at
www.aiaa.org/nasatechdays**



www.nasa.gov/oct