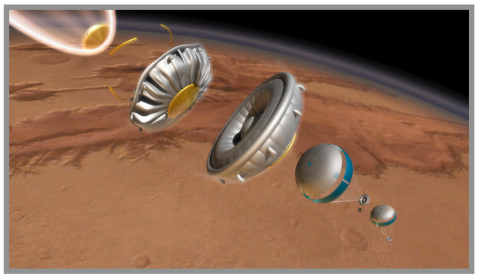
Space Technology: Investments in our Future

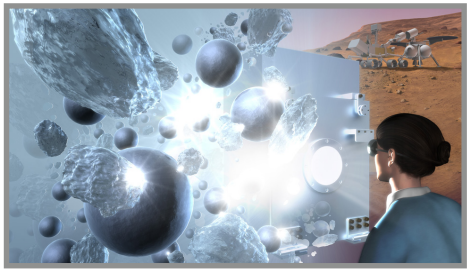
FY12 Overview
March 2011

www.nasa.gov

Space Technology: Investments in Our Future

- **Through NASA, America Continues to Dream Big:** NASA's future aeronautics, science and exploration missions are grand in scope and bold in stature.
- **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 of other government agencies and commercial space activities.
- **NASA at the Cutting Edge:** Pushing the boundaries of aeroscience and taking informed-risk, *Space Technology* allows NASA and our Nation to remain at the cutting-edge.
- **Technological leadership is the "Space Race" of the 21st Century:** NASA's *Space Technology* investments will stimulate the economy and build our Nation's global economic competitiveness through the creation of new products and services, new business and industries, and high-quality, sustainable jobs.
- **NASA makes a difference in our lives everyday**: Knowledge 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. By investing in *Space Technology*, NASA will continue to make a difference in the world around us.



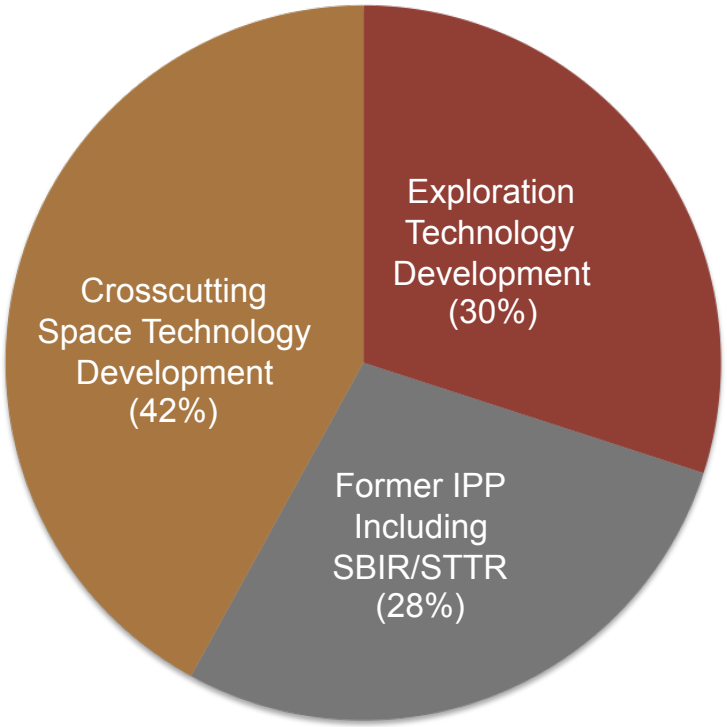


Space Technology

- **Space Technology is a budget line in the FY 2012 request for NASA**
  - Technology development and innovation projects that are broadly applicable to the Agency's future missions in science and exploration while providing space technologies that can improve the capabilities and lower the cost of other government agency and commercial space activities
  - Includes Partnerships, Innovation and Emerging Space (PI&ES), Strategic Integration (SI), Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR), Crosscutting Space Technology and Exploration Technology
  - The President's FY 2012 NASA Space Technology budget request is $1,024 million, a modest increase from the amounts authorized for this suite of programs for FY 2012 in the NASA Authorization Act of 2010, consistent with the Administration's priority on investments in research, technology, and innovation
  - **Managed by Office of the Chief Technologist (OCT)**
- **Space Technology builds on the success of NASA's Innovative Partnerships Program (IPP)**
  - In FY 2011, IPP was integrated into Office of the Chief Technologist and the IPP budget integrated into Space Technology
  - In FY 2012, Exploration Technology activities and budget are integrated into Space Technology
- **Formulation of the Space Technology program is complete**
  - Formally approved by Administrator at July 29 Acquisition Strategy Planning meeting

Proposed FY 2012 Space Technology Budget

- In FY 2012, Space Technology is proposed at approx. 5% of the President's $18.7B request for NASA.
- The $1024M for Space Technology in FY 2012 includes:
  - The SBIR/STTR program and related technology transfer and commercialization activities ($284 million) funded in FY 2010 through NASA's Innovative Partnership Program
  - Movement of a majority of the Exploration Technology Development and Demonstration activities ($310 million) from the Exploration Systems Mission Directorate
  - The Crosscutting technology development activities ($430 million) proposed as part of the President's FY 2011 request.
- All of the Space Technology programs have been carefully formulated over the past year, and have deep roots in technology development approaches NASA has pursued in previous years.
- The FY 2012 request for Space Technology provides a modest increase above the level projected in the NASA Authorization Act of 2010, consistent with the Administration's priority on federal investments in research, technology and innovation across the Nation.
  - The FY2012 request for Space Technology compares with approximately $800 million projected for these same activities in 2012 in the NASA Authorization Act of 2010.



NASA FY2012 Proposed Space Technology Budget ($1024M)

Space Technology Principles

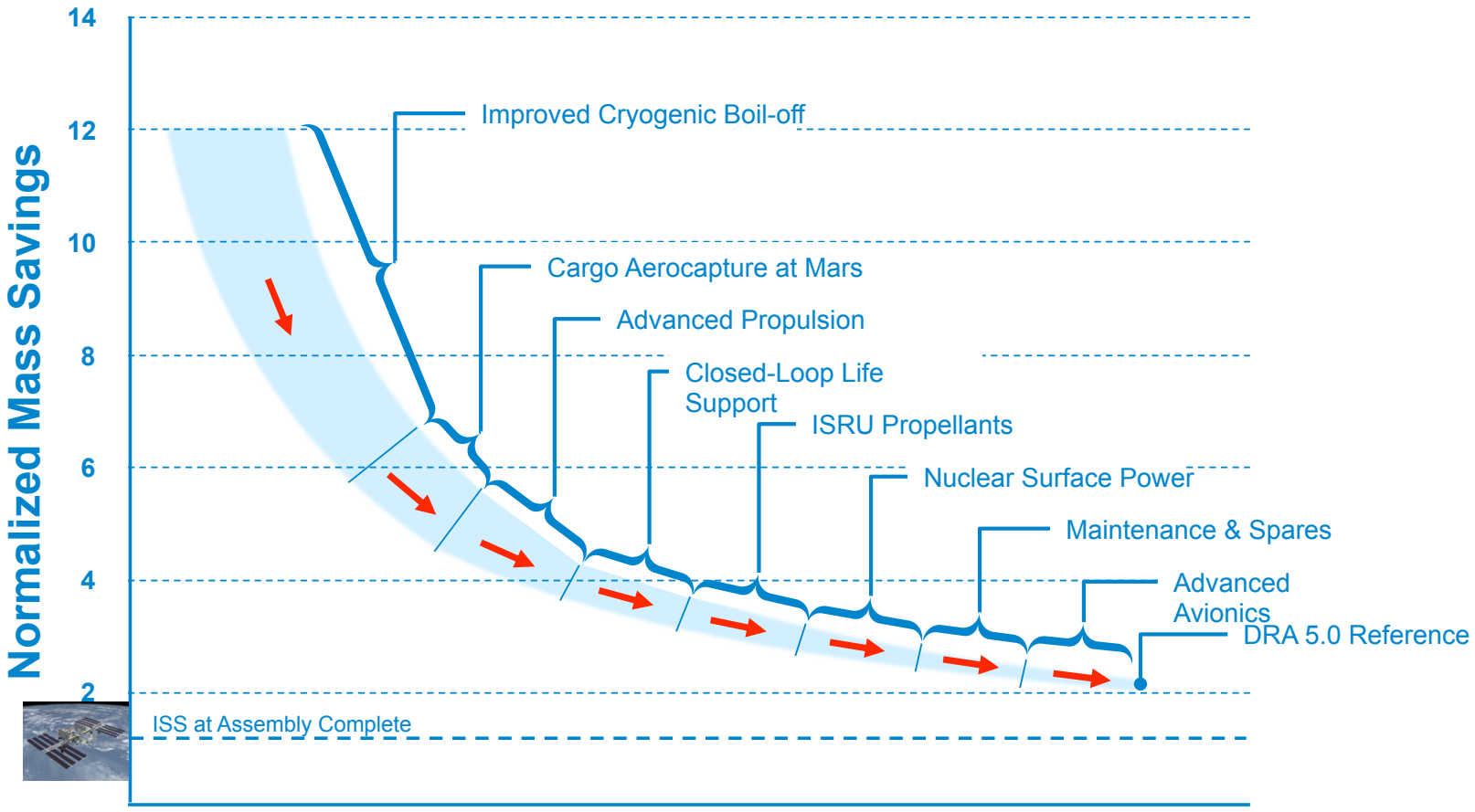
Space Technology shall:

- Advance broadly-applicable technology to produce technology products for which there are multiple customers.
- Advance exploration-specific technologies to infuse into NASA's future human exploration missions that provide the long-range, critical Exploration-specific technologies required to conduct future human exploration missions beyond low Earth orbit with reduced risk and life cycle cost.
- Employ a portfolio approach over the Technology Readiness Level spectrum.
- Competitively select research by academia, industry, and the NASA Centers based on technical merit.
- Leverage the technology investments of our international, other government agency, academic and industrial partners.
- Establish a deliberative panel of internal and external stakeholders, including industry and other government agencies, to review and advise OCT on technology development priorities through a transparent and balanced process.
- Result in new inventions, new capabilities and the creation of a pipeline of innovators trained to serve future National needs.

Space Technology: A Different Approach

- **Strategic Guidance**
  - NASA Strategic Plan
  - Grand challenges
  - Technology roadmaps
- **Full spectrum of technology programs that provide an infusion path to advance innovative ideas from concept to flight**
- **Technical peer-review and competitive selection**
  - Engaging and building an open community of innovators for the Nation
- **Projectized approach to technology development**
  - Defined start and end dates
  - Project Managers with full authority and responsibility
  - Project focus in selected set of strategically defined capability areas
- **Overarching goal is to reposition NASA on the cutting-edge**
  - Technical rigor
  - Pushing the boundaries
  - Take informed risk and when we fail, fail fast and learn in the process
  - Seek disruptive innovation such that with success the future will no longer be a straight line
  - Foster new capabilities, new approaches, and an emerging commercial space industry

The Value of Technology Investments
Mars Mission Example*



- Without technology investments, the mass required to initiate a human Mars mission in LEO is approximately twelve times the mass of the International Space Station
- Technology investments of the type proposed in the FY 2012 budget are required to put such a mission within reach

* The ordering and impact of these technologies are an example valid for one particular architecture and is not intended as an architecture endorsement nor technology development prioritization

Space Technology Improves Our Lives Everyday

- NASA has a long history of technology transfer.
- **By investing in Space Technology, NASA will continue to make a positive difference in the world around us**. The benefits of NASA technology impact our Nation's economy, creating new services and industries in the fields of health and medicine, transportation, public safety, consumer goods, environmental resources, energy and computer technology.
- Each year since 1976, *Spinoff* magazine highlights 40-50 of NASA technology transfer successes from the prior year.
- Nearly 1,700 Spinoff stories are also available online in a searchable format at: http://www.sti.nasa.gov/spinoff/database
- National media continues to focus on commercialization benefits of NASA technologies. OCT has initiated a new weekly web series entity entitled "*Space Tech Improving our Lives" at:*

http://www.nasa.gov/oct

External Input Has Driven Formulation of the NASA Space Technology Program

- **NASA Authorization Act of 2008:** "*A robust program of long-term exploration-related research and development will be essential for the success and sustainability of any enduring initiative of human and robotic exploration of the solar system.*"
- **NRC report, A Constrained Space Exploration Technology Program: A Review of NASA's ETDP, 2008:** *"NASA has created a supporting technology program very closely coupled to the near-term needs of the Constellation Program. This program contains only incremental gains in capability and two programmatic gaps. NASA has effectively suspended research in a number of technology areas traditionally within the agency's scope. This could have important consequences for those portions of the VSE beyond the initial short-duration lunar missions, including extended human presence on the Moon, human exploration of Mars, and beyond."*
- **NRC report, America's Future in Space, 2009:** "*NASA should revitalize its advanced technology development program by establishing a DARPA-like organization within NASA as a priority mission area to support preeminent civil, national security (if dual-use), and commercial space programs."*
- **NRC report, Fostering Visions for the Future: A Review of the NASA Institute for Advanced Concepts, 2009:** "*To improve the manner in which advanced concepts are infused into its future systems, the committee recommends that NASA consider reestablishing an aeronautics and space systems technology development enterprise. Its purpose would be to provide maturation opportunities and agency expertise for visionary, far-reaching concepts and technologies."*
- **Augustine Committee, 2009:** "*The Committee strongly believes it is time for NASA to reassume its crucial role of developing new technologies for space. Today, the alternatives available for exploration systems are severely limited because of the lack of a strategic investment in technology development in past decades.*"
- **NRC report, Capabilities for the Future: An Assessment of NASA Laboratories for Basic Research, 2010:** "*To restore the health of the fundamental research laboratories, including their equipment, facilities, and support services, NASA should restore a better funding and leadership balance between long-term fundamental research/technology development and short- term mission-focused applications.*"

Public Commentary on the Value of NASA's Space Technology Program

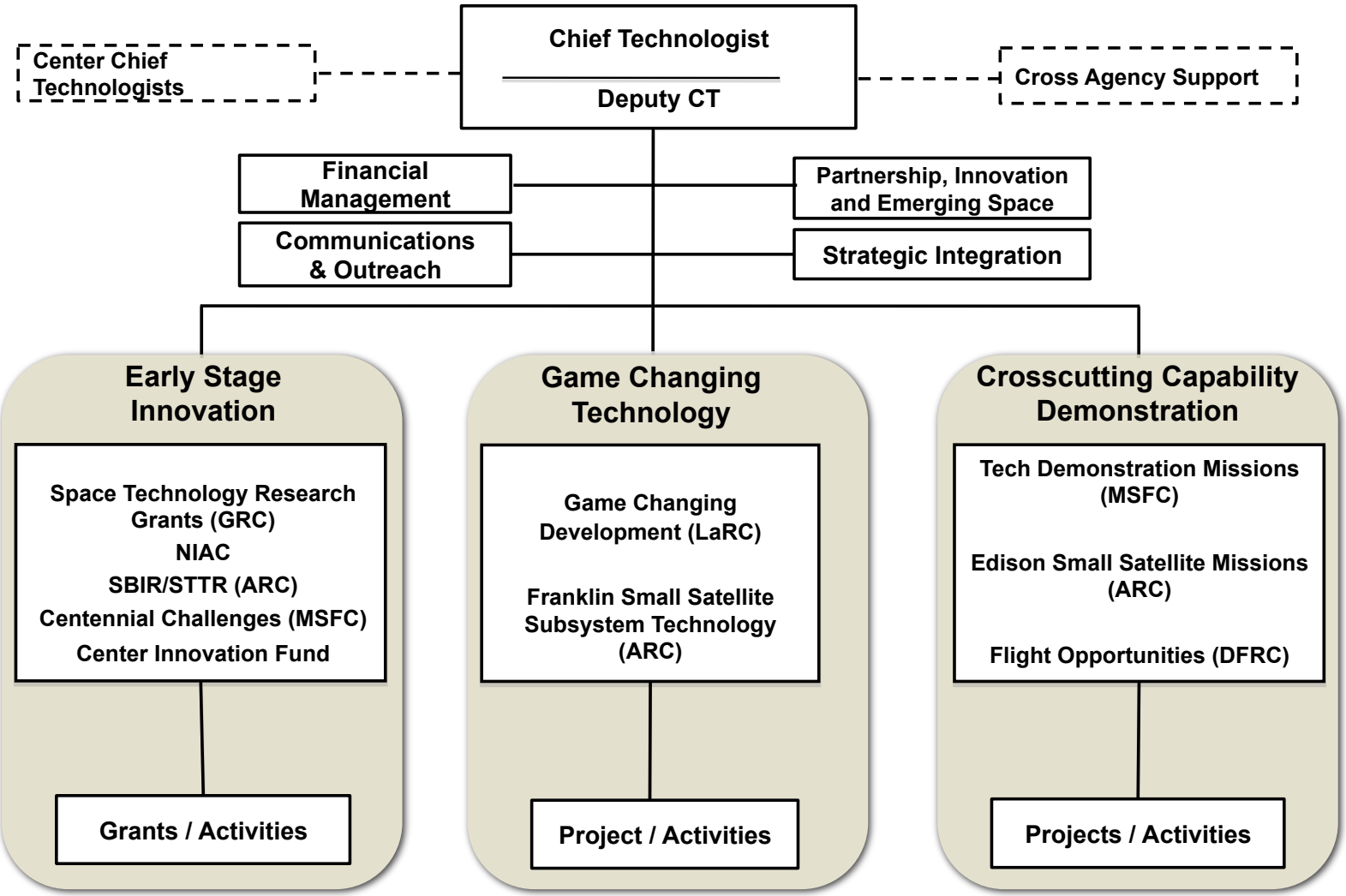
- **Ray Colladay and Bill Ballhaus (9/22/10, Space News): *New Technology for a New NASA***
  "It takes years of steady, robust funding, especially after years of neglect, to build a culture of innovation and collaboration among science and engineering talent in NASA, universities and industry that attracts creative risk-taking to achieve the technology advances that can transform the agency across the breadth of its mission and ensure continued U.S. leadership in space…NASA took an important step in establishing the Office of the Chief Technologist to manage space technology R&D independent of the major engineering development projects, but answerable to the stakeholder users. This is the best way to manage the creative tension between advances promoted by those pushing technology breakthroughs and innovative concepts and technology pulled by needs foreseen by the mission directorates but not yet fully defined by firm requirements…. technologies that could transform NASA and the U.S. space program to once again be an engine for innovation, providing technology solutions that benefit society; creating quality, high-tech jobs that help drive the economy; and inspiring science, technology, engineering and mathematics education.

- **Roger Launius (11/29/10, Space News): *Invest in Tomorrow's Technologies Today***
  "As a percentage of U.S. government investments in R&D, NASA's portion accounted for 14 percent of the nation's total in 1980, but that amount has declined to 7 percent…Without question, the U.S. is at a critical juncture regarding the long-term health of its aerospace enterprise. Knowledge is critical to maintaining America's competitive edge…it is only possible to maintain our leading edge by increasing investments in comprehensive R&D programs."

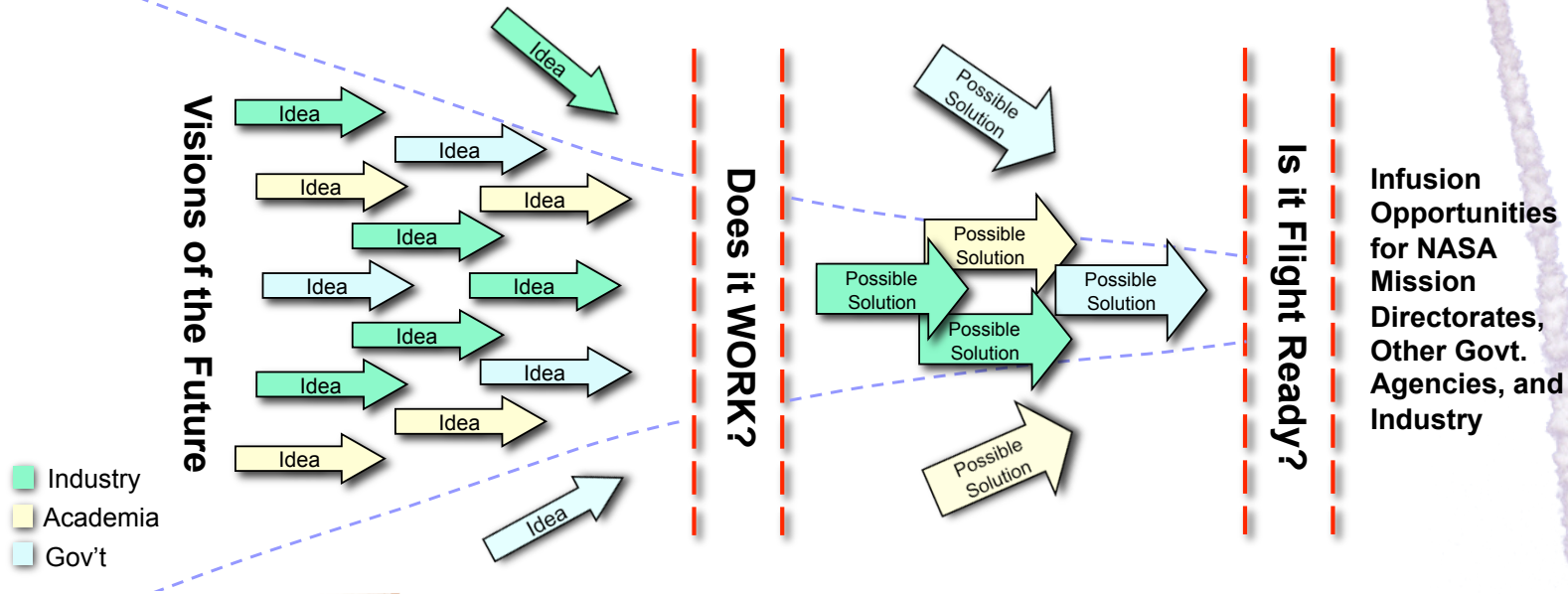
- **George Will (1/2/11, Washington Post): *Rev the Scientific Engine***
  "Stoking that fire is, more than ever, a proper federal function… Such research is what canals and roads once were – a prerequisite for long-term economic vitality…Today, the prerequisites for economic dynamism are ideas. Deborah Wince-Smith of the Council on Competitiveness says: "Talent will be the oil of the 21st century."… U.S. undergraduate institutions award 16 percent of their degrees in the natural sciences or engineering; South Korea and China award 38 percent and 47 percent, respectively. America ranks 27th among developed nations in the proportion of students receiving undergraduate degrees in science or engineering.…Research, including in the biological sciences, that yields epoch-making advances requires time horizons that often are impossible for businesses, with their inescapable attention to quarterly results…As "Gathering Storm" says: Making the government lean by cutting the most defensible - because most productive - federal spending is akin to making an overweight aircraft flight-worthy by removing an engine."

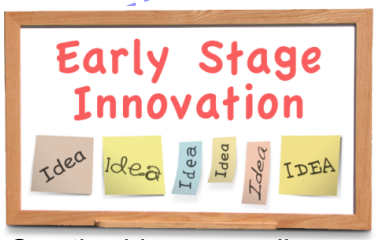
- **Robert Linberg and Douglas Stanley (2/21/11, Space News): *Let's Not Eat Our Seedcorn***
  "Previous NASA investments in space technology enabled the Apollo mission to the Moon and the development of a reusable Space Shuttle, as well as a series of well documented spinoffs and benefits to the American economy. NASA's investment in space technology has shrunk from 10% of its budget in the '70s to 2% today. Because of this chronic underinvestment in space technology, we are retiring the Space Shuttle with nothing ready to replace it in the near future, and we are ill prepared for human exploration beyond low Earth orbit, despite a consensus among Congress, NASA and the White House to pursue such exploration…. NASA needs to immediately invest in a reinvigorated, balanced space technology program.

Office of the Chief Technologist Organization



Space Technology Development Approach

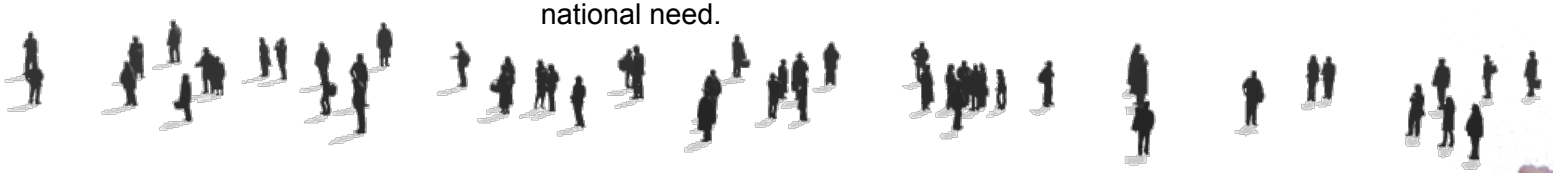




Creative ideas regarding future NASA systems or solutions to national needs.

Prove feasibility of novel, early-stage ideas with potential to revolutionize a future NASA mission and/or fulfill national need.

Mature crosscutting capabilities that advance multiple future space missions to flight readiness status



Space Technology: Return on Investment

- In 2010, the Office of the Chief Technologist commissioned a study by Aerospace Corporation on Return on Investment Calculations of NASA R&D efforts

- Study showed a wide range for ROI depending on the case studies and methodology used*
  - Economic benefit for $1 invested showed a 1.2 to 2.8 multiplier effect.
  - Jobs created for every $1M (FY 2009$) ranged from a factor of 7.8 to 19.4

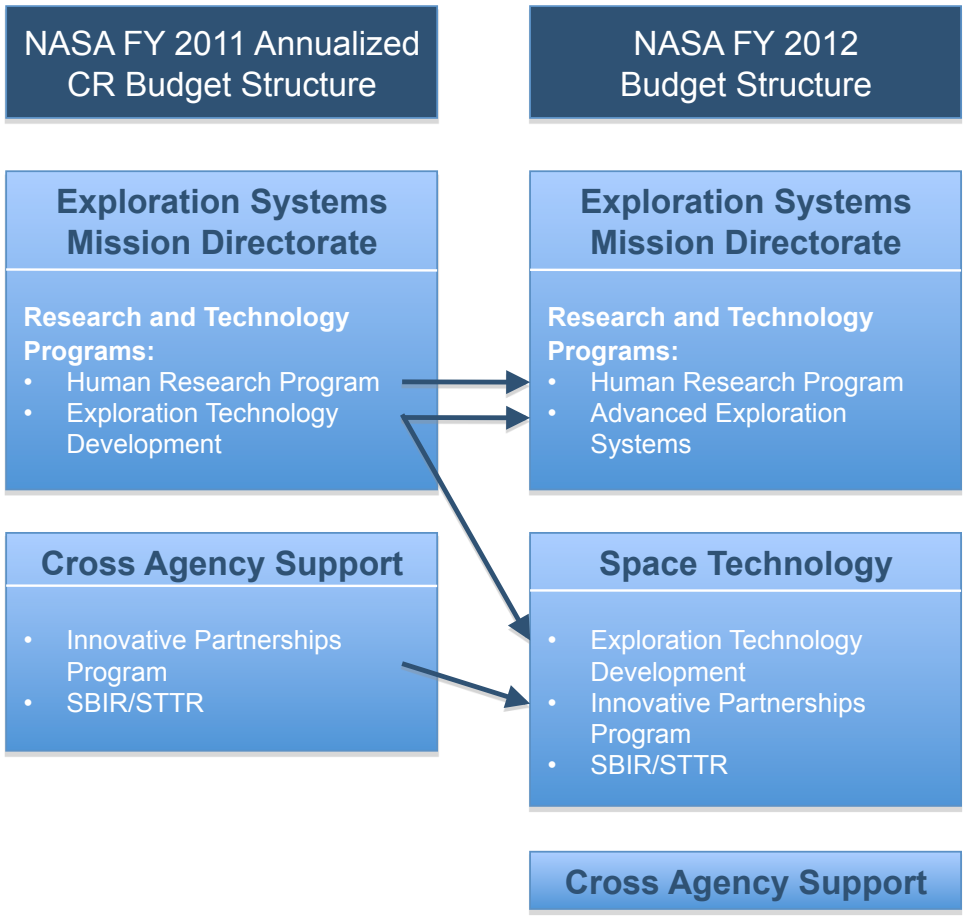
- Using these methodologies one could conclude that $1024M invested in Space Technology could yield an economic benefit of $2.9B and generate as many as 20,000 U.S. jobs

- Additional studies planned for use in assessing NASA's Space Technology investments
  - For example, NASA is a participant in a multi-agency supported NRC workshop on measuring the impacts of Federal investments in research, scheduled for April 2011

* These ROI methodologies assess NASA R&D investment funding, and do not taking into account the leveraging effect of R&D "seed money"

Exploration Technology Development Move Into Space Technology

- In FY 2012, a significant portion of the FY 2010 Exploration Technology Development Program as well as the exploration technology activities in planning for FY 2011 will move from ESMD to Space Technology.
- These efforts focus on developing the long-range, Exploration-specific technologies to enable NASA's deep space human exploration future.
- Integrating Exploration technology activities with Space Technology consolidates the management of NASA's space technology programs within an organization focused on technology development and mission infusion and eliminates the potential for overlap had NASA's space technology investments been split among two accounts.
- OCT will manage the Exploration Technology Development (ETD) within its existing divisions and programs: Game Changing Development (GCD) and Technology Demonstration Missions (TDM)
- OCT will work with ESMD in FY 2011 to complete this transition by the start of FY 2012. In FY12, ESMD will provide prioritized requirements and will remain the primary customer for ETD products.
- Additional guidance planned in March.



Strategic Integration

Accomplishments	Future Plans
Developed Technology Portion of the Agency Strategic Plan	Develop Agency-Level Technology Policy Directives And Procedural Requirements
Defined Space Technology Grand Challenges	Coordinate Monthly Mission Directorate Technology Technical Interchange Meetings
Developed 14 Technical Area Draft Roadmaps And Engaged National Research Council To Collect Industry, Academia And National Information To Refine And Prioritize NASA's Technology Needs	Coordinate Monthly NASA Technology Executive Council Meetings and Center Technology Council Meetings
Coordinated Mission Directorate Technology Technical Interchange Meetings	Develop An Integrated Technology Roadmap And Perform Internal Costing Analysis
Coordinated 5 NASA Technology Executive Council Meetings And 5 Center Technology Council Meetings	Develop Agency-Wide Technology Portfolio Systems And Initiate Use
Performed 2 Technology Feasibility Studies And Initiated 3 Additional Studies	Perform Technology Studies As Required
Chartered 1 Technology Area Working Group	Charter, Manage And Participate In Technology Area Working Groups
	Develop Quarterly And Annual Technology Reports

NASA Space Technology Roadmaps

NASA Authorization Bill of 2010 (Sept 2010)

"In the development of the national space technology development policy, the President or the President's designee shall consult widely with academic and industry experts and with other Federal agencies. The Administrator may enter into an arrangement with the National Academy of Sciences to help develop the policy."

In order for NASA to more effectively and efficiently develop space technologies moving forward, it is necessary to establish a sustained set of clearly identified and prioritized technology development goals.

The NASA Space Technology roadmaps, drafted by NASA, and reviewed and vetted for technology investment identification and prioritization by the NRC, will serve NASA as a decadal-like survey, to provide sustained technology investment goals.

- *Interim report: Sept 2011*
- *Final Report: Jan 2012*

NASA SPACE TECHNOLOGY ROADMAP
TECHNICAL AREA BREAKDOWN STRUCTURE

More information at http://www.nasa.gov/offices/oct/home/roadmaps/index.html

Space Technology Grand Challenges

Space Technology Grand Challenges: a set of important space-related problems that must be solved to efficiently and economically achieve our missions.

We will use the Space Technology Grand Challenges with the Space Technology Roadmaps to prioritize our technology portfolio with an eye towards the Agency's future.

Space Technology Grand Challenges

Expand Human Presence in Space

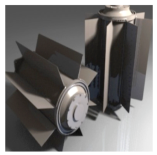
Economical Space Access

Space Health and Medicine

Telepresence in Space

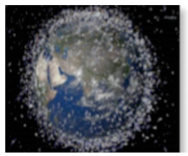
Space Colonization

Manage In-Space Resources

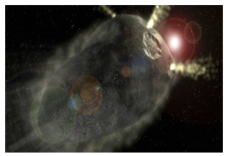


Affordable Abundant Power

Space Way Station

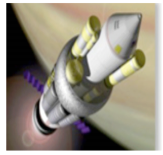


Space Debris Hazard Mitigation

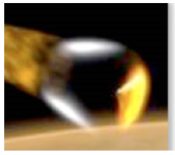


Near-Earth Object Detection and Mitigation

Enable Transformational Space Exploration and Scientific Discovery

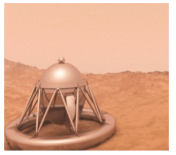


Efficient In-Space Transportation

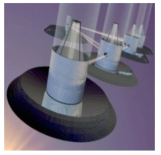


High-Mass Planetary Surface Access

All Access Mobility



Surviving Extreme Space Environments



New Tools of Discovery

More Information at http://www.nasa.gov/offices/oct/strategic_integration/grand_challenges_detail.html

Partnerships, Innovation and Emerging Space

FY 2010 Accomplishments

- Technology Transfer: 300+ Space Act Awards; 290 license agreements; 575 software use agreements; about 80 patents awarded
- Innovation: 41 Innovation Fund Projects; and infused 68+ technologies into various NASA programs

FY 2012 Program Plans

Partnerships

- Transfer and commercialize NASA technology to create jobs, to increase U.S. economic competitiveness, and to save and improve lives every day.
- Leverage resources: a win-win-win for NASA, our partners, and the taxpayer

Innovation

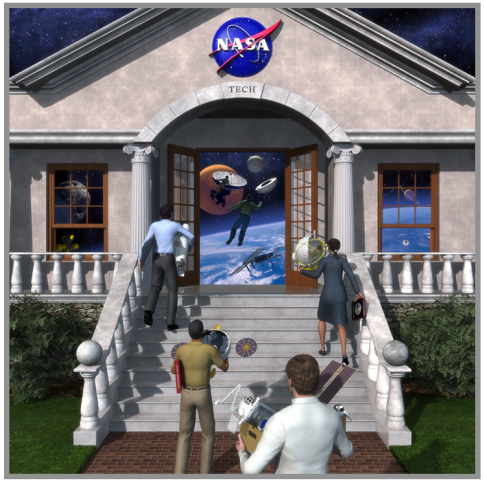
- Explore new models to nurture innovation inside and outside of NASA to accelerate the development of state-of-the-art technology

Emerging Space

- Analyze and facilitate emerging space industry, modeled after how the NACA sparked the growth and success of the world-leading American aviation industry,
- Focus: Targeted sectors include low-cost and reliable access, in-space servicing, space telecom, lunar and asteroid commerce, and microgravity research

Early Stage Innovation Division

The Early Stage Innovation Division sponsors a wide range of low TRL efforts for advanced space system concept and initial technology development across academia, industry and at the NASA field Centers.



- **Space Technology Research Grants Program** focuses on innovative research in advanced space technology grants & graduate fellowships for student research in space technology
- **NASA Innovative Advanced Concepts (NIAC) Program** focuses on innovative aeronautics and space system concepts for future NASA missions
- **Center Innovation Fund Program** stimulates aerospace creativity and innovation at the NASA field Centers
- **Centennial Challenges Prize Program** addresses key technology needs with new sources of innovation outside the traditional aerospace community
- **Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) Program** engages small businesses in our Nation's space enterprise and infuse these products across NASA missions

All Early Stage Innovation selections will be made competitively

Game Changing Technology Division

- The Game Changing Technology Division focuses on maturing advanced space technologies that may lead to entirely new approaches for the Agency's future space missions and solutions to significant national needs.
- Through ground-based testing and/or laboratory experimentation, the Game Changing Technology Division matures technologies in preparation for potential system level flight demonstration.
- Success is not assured with each investment; however, on the whole and over time, dramatic advances in technology, enabling entirely new NASA missions and potential solutions for a variety of society's technological challenges are expected.

- **Game Changing Development Program** focuses on innovative ideas enabling new capabilities or radically altering our current approaches to space systems
- **Franklin Small Satellite Subsystem Technology Program** enables small satellites to provide game changing capabilities for the space sectors

Crosscutting Capability Demonstrations Division

- The Crosscutting Capability Demonstrations Division focuses on maturation to flight readiness of cross-cutting capabilities that advance multiple future space missions, including flight test projects where in-space demonstration is needed before the capability can transition to direct mission application.
- Matures a small number of technologies that benefit multiple customers to flight readiness status (TRL 7) through Projects that perform relevant environment testing.

- **Edison Small Satellite Demonstration Missions Program** develops and operates a series of NASA-focused small satellite demonstration missions in collaboration with academia and small business
- **Flight Opportunities Program** provides flight opportunities of reduced-gravity environments, brief periods of weightlessness, and high-altitude atmospheric research
- **Technology Demonstration Missions Program** matures, through flight demonstrations, a small number of Agency crosscutting technologies in partnerships with the NASA Mission Directorates, industry, academia and other government agencies

Opportunities

- SBIR/STTR, Flight Opportunities, Center Innovation Fund, Centennial Challenges are ongoing programs, funded in FY 2011 CR based on enacted FY 2010 levels.
- Inaugural Space Technology Graduate Fellowship call closed on February 23. Selections anticipated for start of Fall 2011 semester.
- Initial NIAC, Game Changing Development, Technology Demonstration Missions calls released on March 1. Presently open.
  - NIAC seeks transformative ideas to enable new aeronautics and space systems capabilities.
  - Game Changing Development is soliciting proposals for research and technology development for revolutionary improvements in America's space capabilities.
  - TDM proposals are sought in four areas: high-bandwidth deep space communication, navigation and timing; orbital debris mitigation or removal systems; advanced in-space propulsion systems; and autonomous rendezvous, docking, close proximity operations and formation flying.

    http://www.nasa.gov/offices/oct/home/solicitations.html
- All proposals must align with the Agency's Space Technology Roadmaps and Grand Challenges. Awards are contingent on availability of fiscal year 2011 appropriations.
- OCT is not planning to make awards in Space Technology Research Grants, Franklin Small Satellite Subsystem Technology and Edison Small Satellite Demonstration Missions until FY12.

Approximate Number of New Space Technology Awards by Fiscal Year

Planned Space Technology Awards[1]	FY11 $350M[2]	FY12 $1024M[3]
Space Technology Research Grants	0	50
Space Technology Graduate Fellowships	150	350
NIAC Phase I	7-10	15-20
NIAC Phase II	0	3-5
Center Innovation Fund	25	125
SBIR/STTR Phase I	400	400-500
SBIR/STTR Phase II	200	200-225
New Centennial Challenges	0	3
Game Changing Development Projects	5	12
Franklin Small Satellite Technologies	0	4
Technology Demonstration Missions	1	2
Edison Small Satellite Missions	0	3
Flight Opportunities Parabolic Flight Experiments	20	50
Flight Opportunities Commercial Reusable Suborbital Flight Experiments	2	6
Exploration-specific Game Changing Development Projects	-	12
Exploration-specific Technology Demonstration Missions	-	1

[1] Award Numbers denote number of **new** awards by Fiscal Year. All awards numbers are contingent on the quality of proposals received.
[2] $350M for Space Technology based on FY 2010 NASA Authorization Act within the Aeronautics account. This account does not include Exploration Technology.
[3] $1024M for Space Technology based on FY 2012 President's Budget Request within the new Space Technology account. This account includes Exploration Technology.

NASA Space Technology: Part of a Broader National Strategy

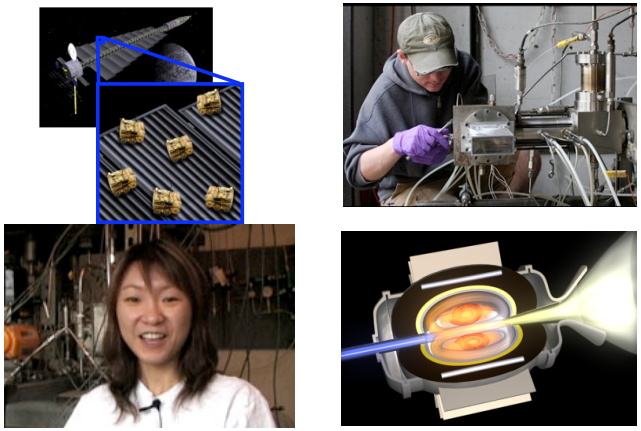
- **Space Technology is the central NASA contribution to a revitalized research, technology and innovation agenda for the Nation. These investments will stimulate the economy and build our Nation's global economic competitiveness through the creation of new products and services, new business and industries, and high-quality, sustainable jobs.**
  - A renewed technology emphasis balances NASA's long-standing core competencies of research and technology, spaceflight hardware development, and mission operations.
  - An enhanced technology and innovation focus at NASA responds to the recommendations of multiple external stakeholders.
  - 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 of other government agencies and commercial space activities .
- **Pushing the boundaries of aeroscience and taking informed-risk, Space Technology allows NASA and our Nation will remain at the cutting-edge.**
- **In addition to providing a more vital and productive aerospace future, by investing in Space Technology, NASA will continue to make a difference in our lives everyday.**

President Obama, February 3, 2011, at Penn State: "*Innovation is what this country is all about. Sparking the imagination and creativity of our people, unleashing new discoveries -- that's what America does better than any other country on Earth. That's what we do. We need you to seek breakthroughs and new technologies that we can't even imagine yet.*"

BACKUP 1: THE 10 Space Technology Programs

Space Technology Research Grants

Level II Program Office: GRC



Objective: Accelerate the development of push technologies through innovative projects with high risk/high payoff

- **Grants:** Low TRL technology portfolio for foundational research in advanced space systems; *Space Technology equivalent to ARMD Fundamental Aeronautics Program.*
- **Fellowships:** Competitive selection of U.S Citizen / permanent resident graduate student that shows promise for future application toward NASA missions and strategic goals

Acquisition Strategy

- **Grants**: NRA calls anticipated once or twice annually
- **Fellowships:** Selected candidates will perform graduate student research on their respective campuses, at NASA Centers and not-for-profit Research and Development (R&D) labs. Each student matched with a technically relevant and community engaged researcher who will serve as the student's professional advisor.

Awards

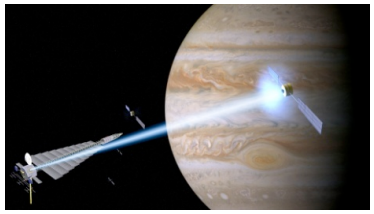
- **Grants**: Typical 12 months awards at $250K. 100+ per year
- **Fellowships:** Building up to 500 active students per year.

Collaboration

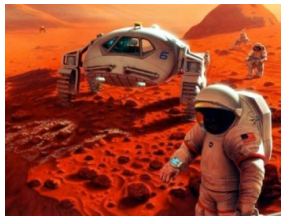
- **Grants:** Academia, not-for-profit R&D labs & NASA Centers lead proposals; others team.
- **Fellowships:** Strong collaboration is anticipated between NASA Centers/R&D Labs & Academia

NASA Innovative Advanced Concepts (NIAC)

Managed at NASA Headquarters



Studies exploring future space missions



Involve industry, academia & NASA to revolutionize space access, operations & utilization

Objective: NIAC is focused on early studies of visionary, long-term concepts

- Aerospace architecture, system, or mission concepts (TRL 1-2, 10+ years from application)
- OCT is re-establishing this effort as the *NASA Innovative Advanced Concepts* program
  - Guided by NRC findings and recommendations*
  - Run internally from HQ, and allowing internal NASA/JPL participation

Acquisition Strategy

- **Phase 1:** Examine the overall viability of an innovative system or concept
- **Phase 2:** Study major feasibility aspects (cost, performance, development time, key issues) and potential infusion path; competitively selected from successful Phase I
- Selections will be based on independent peer review of all qualified proposals; competition of ideas

*NRC report, Fostering Visions for the Future: A Review of the NASA Institute for Advanced Concepts, 2009

Awards

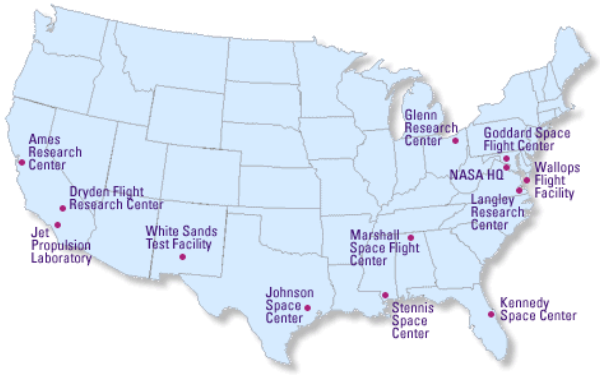
- **Phase 1**: Up to 1 year, $100K; 15-20 per year
- **Phase 2**: up to 2 years, $500K; 3-8 per year

Collaboration

- Proposals welcome from all sources, including academia, industry, all US government agencies (including NASA and JPL), and partnerships.

Center Innovation Fund

Managed at each NASA Center



Objective

To stimulate and encourage creativity and innovation within the NASA Centers. The activities are envisioned to fall within the scope of NASA Space Technology or technology addressing a significant National need.

Acquisition Strategy

- Through the Center Chief Technologist, Centers will conduct competitions to select ideas/projects and provide appropriate oversight. Detailed feedback on these activities will be required before the end of each FY.
- Center activities will be scored and will affect funding distribution in subsequent years

Awards

- The funds will be distributed among the ten NASA centers to allow Centers to support low TRL innovative technology initiatives that leverage Center talent and capability.

Collaboration

- Partners will be sought out by the Centers for the pursuit of innovation that is of common interest to leverage these resources
- Partners will include other NASA Centers, private sector firms, universities, other government agencies and FFRDCs.

Centennial Challenges

Level II Program Office: MSFC

Since 2005, 20 competitions held in six Challenge areas, $4.5M in prizes awarded to 13 different teams

Objective: Seek innovative solutions to technical problems that can drive progress in aerospace technology of value to NASA and the nation.

- Direct public participation in NASA's research and development with cash prize incentives
- Spur technology innovation with unconventional solutions from diverse sources
- Create new products and businesses and new suppliers and partners for NASA

Acquisition Strategy

- NASA consults widely within and outside of the federal government in selecting topics for prizes.
- Awards are only made for successful demonstrations of design solutions.
- NASA provides the prize purse and the competitions are managed at no cost to NASA by external non-profit organizations.
- Competitions are open to all US entities and citizens.

Awards

- Typical Prize amount is $100K to $2M
- 100% of program funds are for prize awards. No funding for challenge administration
- New appropriations will enable new and more ambitious prize competitions.

Collaboration

- Partnerships with non-profit organizations to administer challenges and competitions are open to all.

http://www.nasa.gov/challenges

Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR)

Level II Program Office: ARC

2009 NASA SBIR grant for an advanced Lunar Surface Navigation system

Inflatable Technology to develop a rigidized thin film antenna for large aperture ground-based antenna; i.e. lunar ground station

Objective: To engage and provide opportunity to small businesses to participate in Federal Research activities and encourage cooperative research and development with non-profit research institutions, such as a university; with a primary objective of developing and facilitating the transfer of technology from research institutions through the entrepreneurship of small business contracts that result in technology to meet NASA's needs.

- Provide opportunities to participate in Federal Research activities
- Encourage cooperative research and development with non-profit research institutions

Acquisition Strategy

- Current Authorization provides for SBIR funding at a minimum of 2.5 percent of NASA's extramural research and development expenditures
- Modeled after SBIR, STTR is a separately funded activity; with funding set at a minimum of 0.3 percent of extramural research and development expenditures

Awards

- **Phase 1**: Up to 400 awards per year
- **Phase 2**: Up to 200 awards per year

Collaboration

- Proposals welcome from small business concerns, in partnership with non-profit research institutions; such as a university.
- The percentage of new firms participating in NASA's SBIR/ STTR programs each year has been in the 27%-35% range, yielding new applicants each year. New participants have submitted between 20-35% of the total number of proposals in any given year.

http://sbir.gsfc.nasa.gov/SBIR/SBIR.html

Game Changing Development (GCD) Program

Level II Program Office: LaRC

Objective

•Innovative, novel, and unique technology development that promise to enable revolutionary improvements in our country's space capability
  – Promote innovative capabilities that cut across many NASA specific needs
  – Demonstrate promising technologies for high payoff advancement
  – Promote revolutionary technology advancement to radically change the was NASA approaches its missions
• TRL Maturation: From TRL 3-4 to TRL 5-6

Acquisition Strategy

- Annual open call NRA for innovative, unique technologies
- At least 8-9 focused program developments in selected technology areas such as horizontal launch, adaptive re-entry, beamed energy
  - Competitively selected multiple awards in each program
  - Level 2 Program Office implementation

Awards

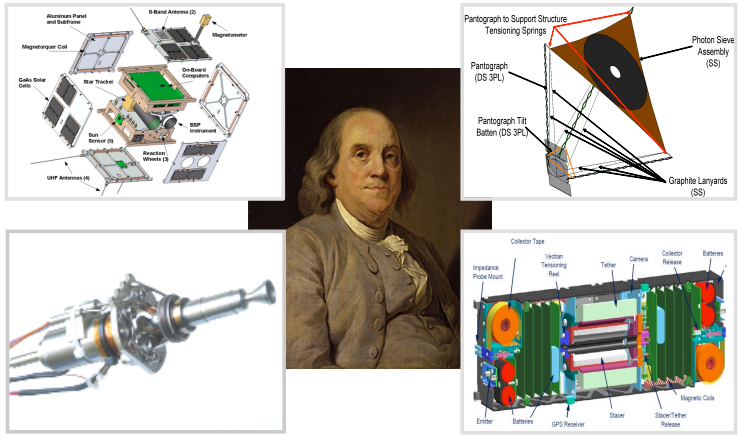
- ~10-12 new awards/year at $1-10M per year.

Collaboration

- Open to academia, industry, and federal laboratories with partnering encouraged.

Franklin Small Satellite Subsystem Technology

Level II Program Office: ARC



Objective

- Mature technologies that enable small satellites to provide disruptive capabilities for the government and commercial sectors. At completion, the subsystem deliverables should be ready for flight production and demonstration in space.
- TRL Maturation: From TRL 3-4 to TRL 5-6

Acquisition Strategy

- Annual BAA.
- At least 2-8 new competitively selected awards each year.
- One-year base activity with up to two, one-year options

Awards

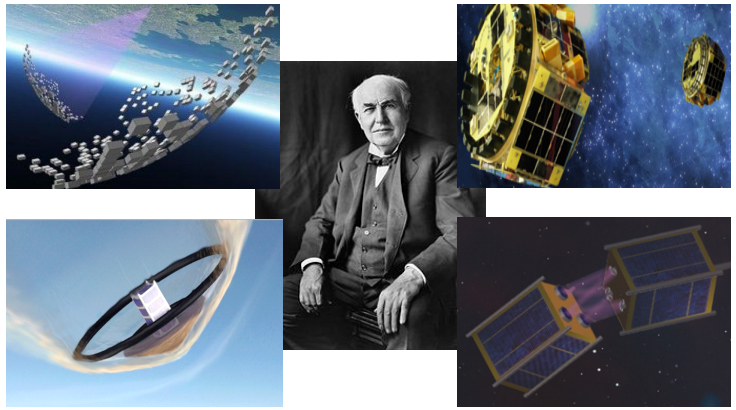
- ~2-8 new awards/year at $100 thousand to $3 million per year.

Collaboration

- Open to academia, industry, and federal laboratories with partnering encouraged.

Edison Small Satellite Demonstration Missions

Level II Program Office: ARC



Objective

- Develop and operate a series of small satellite technology demonstration missions with disruptive potential for multiple applications in the government and commercial sectors. Provide science and educational missions of opportunity as secondary objectives. Improve secondary payload space access.
- TRL Maturation: From TRL 5-6 to TRL 6-7

Acquisition Strategy

- Annual BAA.
- At least 1-2 new competitively selected awards each year.
- Subsystem Validation Missions – Less than 2 years to launch readiness and $1-10 million mission cost.
- Mission Capability Demonstrations – Less than 3 years to launch readiness and $1-20 million mission cost.

Awards

- ~1-2 new awards/year at $1-20 million per year.

Collaboration

- Open to academia, industry, and federal laboratories with partnering encouraged.

Flight Opportunities

Level II Program Office: DFRC

Objective: Provide flight opportunities in reduced-gravity and high-altitude environments toward maturation of technology for application in future space missions. The Flight Opportunities Program combines the FY 2010 FAST and CRuSR efforts previously managed by NASA's Innovative Partnership Program. Goal of expanding program to other platforms and test environments in FY 2012.

- CRuSR will procure commercial suborbital space transportation and payload integration services to provide 3-4 minutes of microgravity environment for tech development, scientific, and university research
- FAST will procure commercial parabolic flights to test technologies in environments that simulate microgravity and the reduced gravity environments of the Moon or Mars

Acquisition Strategy

- CRuSR – Solicitation of commercial flight and payload integration services on operational and developmental suborbital platforms; RFI release December 21, 2010; Solicitation release March 2011
- FAST – Utilize existing Zero-G contract for payload accommodation on commercial parabolic flights
- Open call to researchers to gain access to CRuSR and FAST flight opportunities to test technologies in a relevant space environment; Call released December 21, 2010

Awards

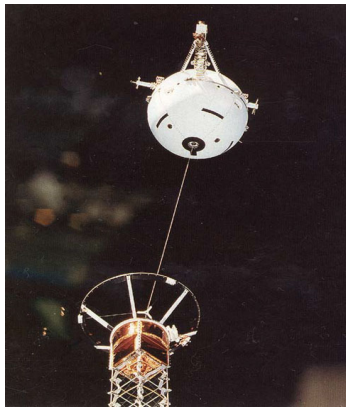
- Parabolic flights: FY 2011 up to 2 flight weeks/ year with up to 15 payloads/flight week
- Suborbital flights: ~$11M of flights and services purchased through multiple vendors

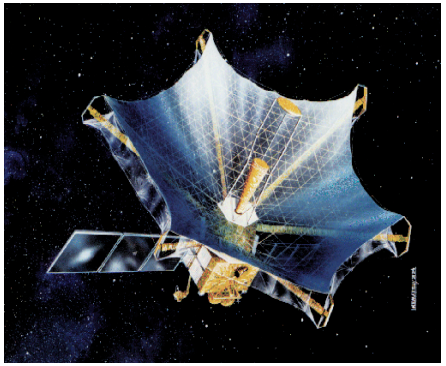
Collaboration

- Suppliers: Industry and emerging commercial suborbital platform providers supply flights to access simulated space environments
- Users: Industry, Academia, Government researchers propose technology payloads to be flown on procured flights

Technology Demonstration Missions

Level II Program Office: MSFC





Objective

- Mature revolutionary, crosscutting technologies that benefit multiple customers to flight readiness status (TRL 7) through projects that perform relevant environment testing.
- Infuse game changing, crosscutting technologies into the critical path of future missions
- The primary objective is to help “bridge the gap” by maturing system-level space technologies through mission infusion.

Acquisition Strategy

- **Focused BAA: System-level Capability Demonstration Proposal**
  - Full flight demonstration proposal; maximum 30 pages
  - Three months for proposal submission
  - Three years from ATP to launch readiness
  - Mandatory 25% cost sharing of total lifecycle mission cost to facilitate infusion

Awards

- Maximum three year development schedule.
- Typical project life cycle cost (from OCT): $150M.

Collaboration

- Minimum 25% partner contribution to demonstrate infusion interest.
- Proposal teams may include NASA Centers, government agencies, industry and academia, with partnerships strongly encouraged.