

National Aeronautics and Space Administration



OFFICE OF THE CHIEF TECHNOLOGIST

SPACE TECHNOLOGY  
**INDUSTRY FORUM**

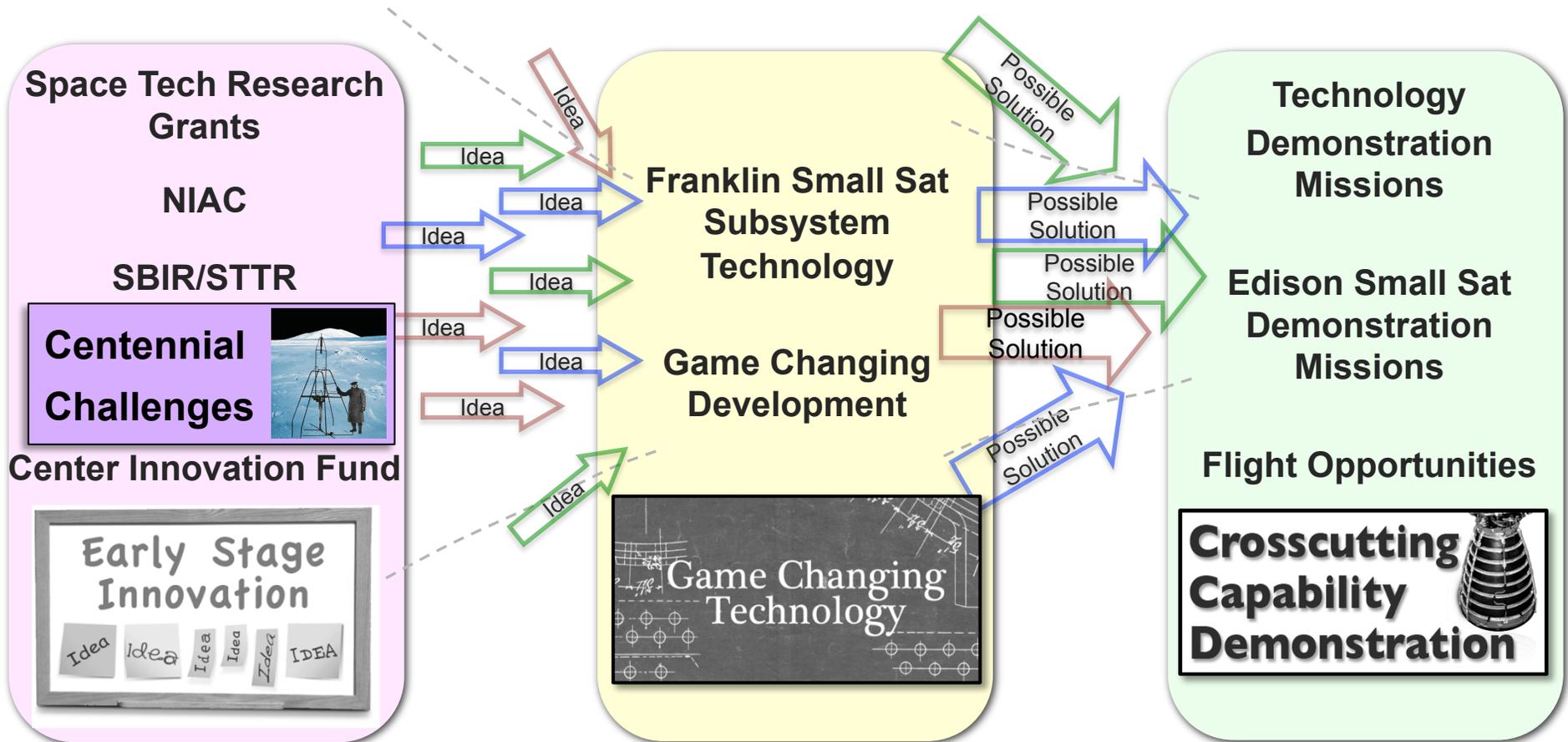
A woman in a dark jacket and pants stands on the right side of a yellow-toned, futuristic industrial or technological environment. The background is filled with complex machinery, pipes, and structural elements, creating a sense of depth and scale.

## Centennial Challenges Program

**Andrew Petro**  
Program Executive  
July 13, 2010



# OCT Program Overview



Technology Readiness Level (TRL)

# Participatory Research & Development



Kansas City Space Pirates  
NASA Dryden Flight Research Center  
November 2009

Brian Turner  
Kansas City Space Pirates  
Power Beaming Team  
New York Times Magazine  
July 1, 2007

**Incentive prizes to encourage novel solutions from  
non-traditional sources**

July 13, 2010

# NASA Prizes for the Citizen Inventor



- Authorized by Congress in 2005
- Administered by non-profit Allied Organizations
- NASA provides only prize money
- Allied Organizations seek sponsors for operating funds
- Sponsors can add to prize money
- NASA concurs on rules and competition plans
- \$10M appropriated in 2005
- \$4M appropriated in 2010
- Funds do not expire – allows multi-year agreements
- Competitors cannot be supported by government funding
- Prizes can only go to US citizens, permanent residents or US entities



ALLIED ORGANIZATIONS 2005-2010

July 13, 2010

[www.nasa.gov/oct](http://www.nasa.gov/oct)

# Centennial Challenges' Status



## Completed

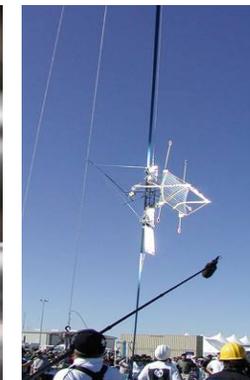
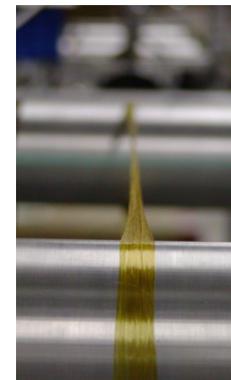
- Regolith Excavation – \$750K awarded
- Lunar Lander – \$2M awarded
- Astronaut Glove – \$550K awarded

## On-Going

- Strong Tether – \$2M available
- Power Beaming – \$900K awarded;  
\$1.1M available in 2010
- Green Flight – \$350K awarded;  
\$1.65M available in 2011

## New in 2010

Three New Challenges with \$5M available



**Since 2005, 19 competitions held in six Challenge areas, \$4.5M in prizes awarded to 13 different teams**

# Model for Government-sponsored Prizes



Photo: New York Times

“NASA’s Centennial Challenges have triggered an outpouring of creative solutions from students, citizen inventors, and entrepreneurial firms for technologies such as lunar landers, space elevators, fuel-efficient aircraft, and astronaut gloves.”

*Memo to all Executive Departments and Agencies from Office of Management & Budget*  
**Guidance on the Use of Challenges and Prizes to Promote Open Government,**  
March 8, 2010

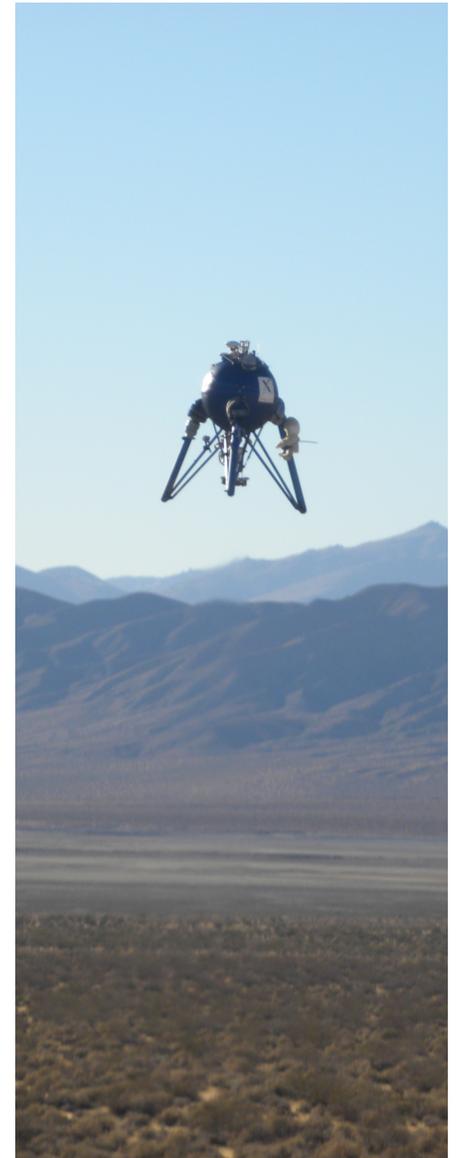
July 13, 2010

[www.nasa.gov/oct](http://www.nasa.gov/oct)

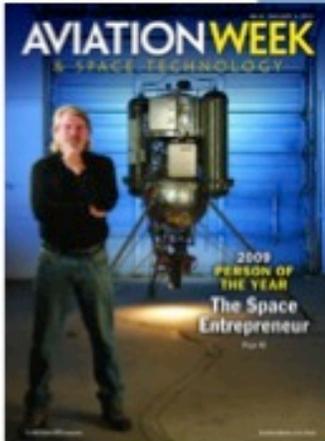
# Benefits of Challenges



- **Stimulate innovation in ways unlike contracts or grants**
  - Reward achievement, not effort
- **Reach new sources of innovation, new talent**
  - Multiple teams & multiple approaches to same problem
- **Stimulate new commercial ventures**
  - New startups, new partners, more commercial competition
- **Achieve returns that outweigh investment**
  - High ratio of private investment to prize value
  - Almost all funds go to prize purses
- **Educate, inspire and motivate the public**
  - Train the future workforce
  - Increase awareness of science & engineering
  - Inclusion, not exclusion



# Centennial Challenges 2009 Highlights



Masten Space Systems and Armadillo Aerospace win Lunar Lander Challenge and as Space Entrepreneurs are honored as the "Persons of the Year"



Paul's Robotics, a student team beats 22 others to win \$500,000 in the Regolith Excavation Challenge



Ted Sothern and Peter Homer display their prize winning Astronaut Gloves



LaserMotive climbs to one kilometer with beamed power to win \$900,000



# Centennial Challenges Upcoming Activities



## In 2010

- Preparation underway for Strong Tether, Power Beaming and Green Flight Challenges
- Three new Challenge topics selected
- New Allied Organizations will be selected – October
- Program has received positive attention as new Administration promotes prize challenges for all federal agencies

## For FY2011

- As part of OCT, a Program Office will be established at the Marshall Space Flight Center – to enhance partnership opportunities and technology infusion
- Budget request is \$10M each year through 2015
  - an average of 5 new challenges per year

# Strong Tether Challenge



**August 13, 2010**

**Microsoft Conference Center, Redmond, WA**

***Managed by: Spaceward Foundation***



For advanced materials including practical carbon nano-tubes

*On-going since 2005*

\$2M for strongest sample that exceeds strength of best commercially available material by 50% in pull test.

Prize	Length	Mass	Strength
\$300,000	$\geq 1$ cm	$\leq 0.01$ g	5.0 MYuri
\$300,000	$\geq 10$ cm	$\leq 0.1$ g	5.0 MYuri
\$400,000	$\geq 1$ m	$\leq 1.0$ g	5.0 MYuri
\$1,000,000	$\geq 1$ m	$\leq 1.0$ g	7.5 MYuri

1 MYuri = 1 GPa/(g/cc)

July 13, 2010



[www.nasa.gov/oct](http://www.nasa.gov/oct)

# Power Beaming Challenge



Fall, 2010

*Managed by: Spaceward Foundation*



## REQUIREMENTS

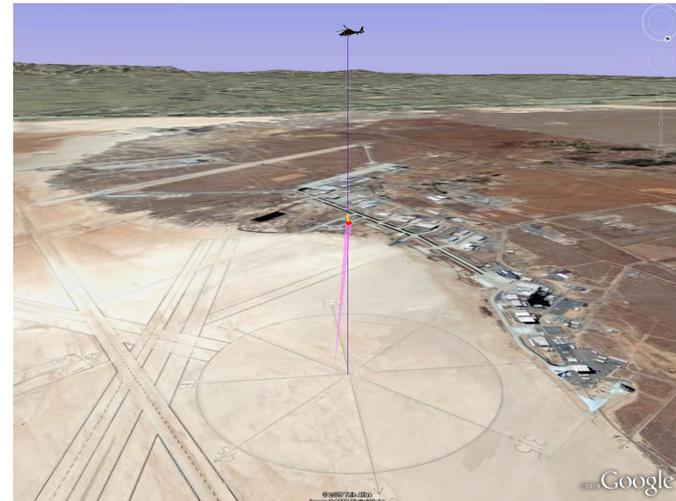
Climb vertical cable to **1 km**

With beamed energy

Score based on speed and payload

**PRIZES – \$1.1M** to be divided among teams based on score for teams that exceed 5 m/s speed

\$900 K won by one team in 2009



Ground-based lasers, up to 8 kW, used with photovoltaic receivers and active tracking

# Green Flight Challenge



July 2011

Sonoma County Airport, Santa Rosa, California



*Managed by: Comparative Aircraft Flight Efficiency Foundation*

## REQUIREMENTS

≥ 200 mile range

≥ 100 miles/hour

≥ 200 passenger-miles/gallon

(energy equivalent with fuel or electricity)

Repeat flight on consecutive days

## PRIZES

**\$1.5M** to aircraft with best combination of efficiency and speed

**\$150K** to best-performing bio-fueled aircraft



July 13, 2010

[www.nasa.gov/oct](http://www.nasa.gov/oct)

12

# Three new prize challenges for 2010



**Total prize purse: \$5 Million**

Student-Level competitions in each area

Announcement of Partnership Opportunities for new Allied Organizations - July 13; Proposals due Sept 13

Request for Information from Potential Sponsors posted in June

**Watch for Updates at: [www.nasa.gov/challenges](http://www.nasa.gov/challenges)**

# Nano-Satellite Launch Challenge



to place a small satellite into Earth orbit, twice in one week.

## PRIZE PURSE: \$2 Million

Satellite mass - at least 1 kg

Satellite dimensions

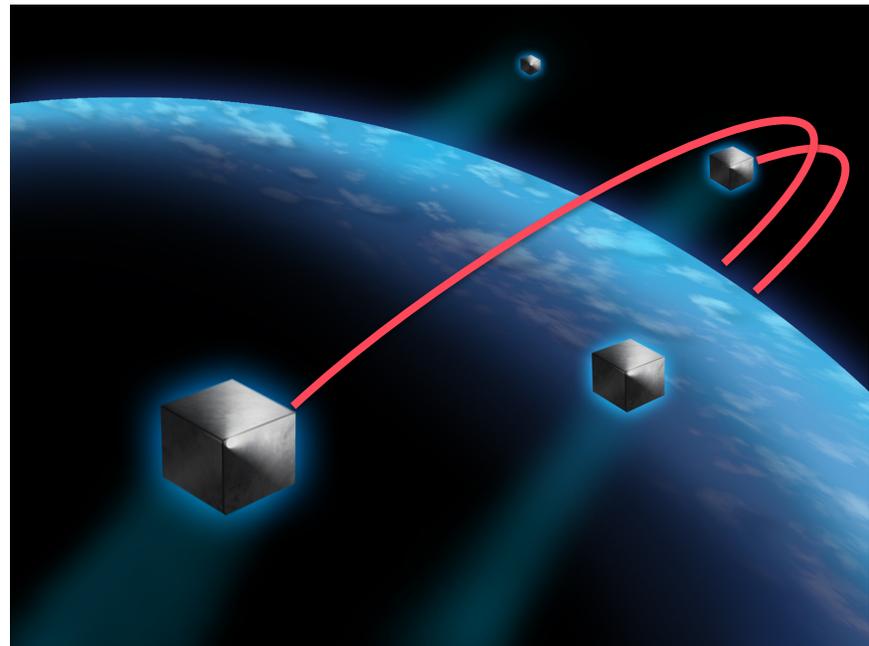
- at least 10 cm cube

Must complete at least one Earth orbit

Task must be accomplished twice in one week

*To stimulate innovations in launch technology*

*To encourage creation of commercial nano-sat delivery services*



# Night Rover Challenge

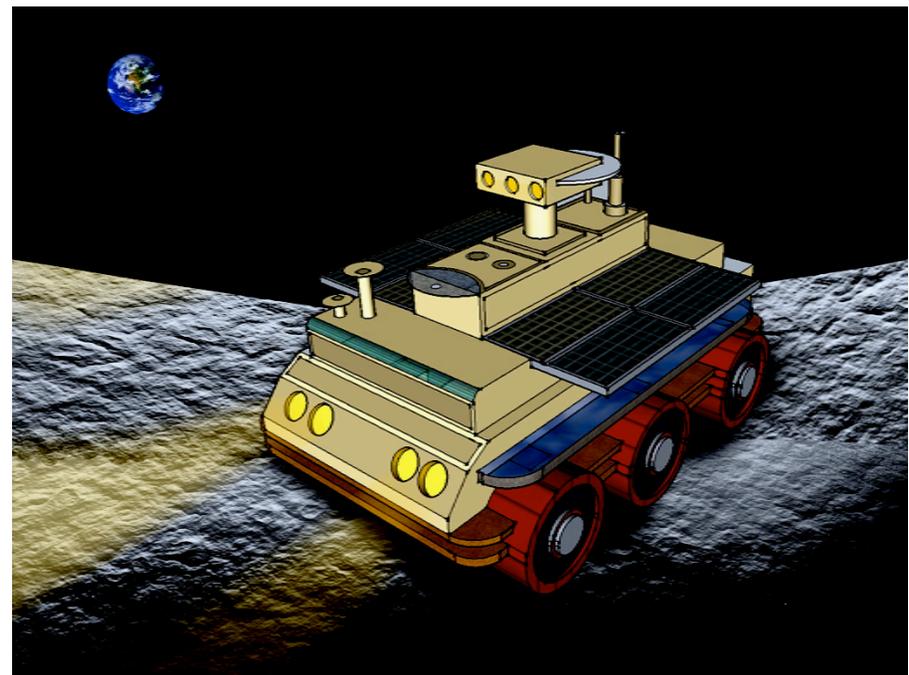


to demonstrate a solar-powered exploration vehicle that can operate in darkness using its own stored energy.

## PRIZE PURSE: \$1.5 Million

Vehicle generates and stores its own energy using a renewable source available on the Moon and operates over several daylight/darkness cycles

*To stimulate innovations in energy storage technologies of value in extreme space environments and in renewable energy systems on Earth.*



# Sample Return Robot Challenge

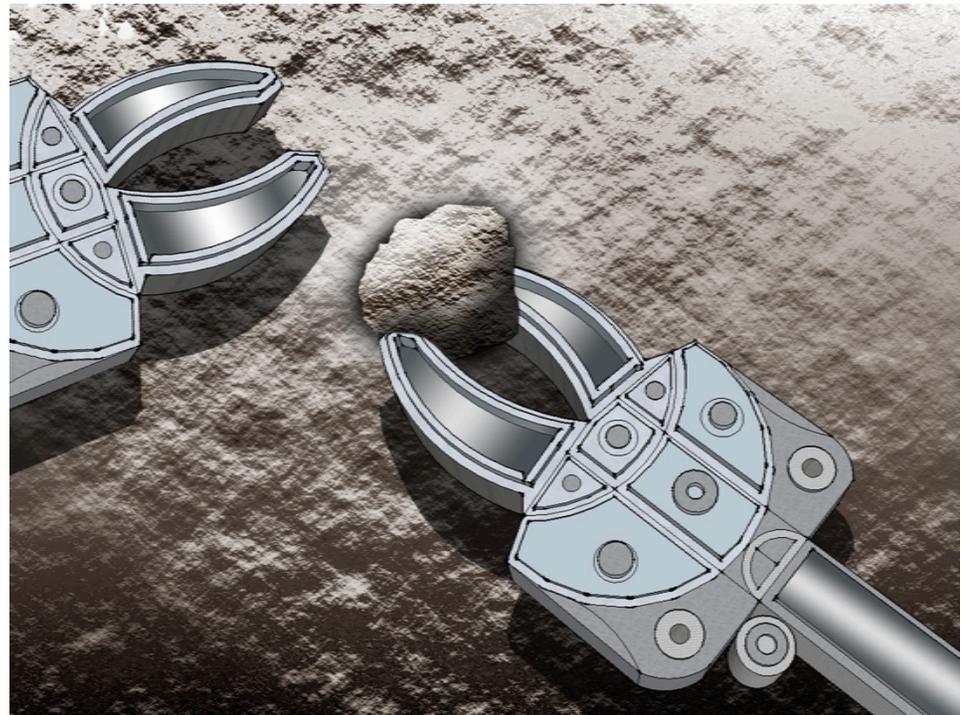


to demonstrate a robot that can locate and retrieve geologic samples from a wide and varied terrain without human control.

## PRIZE PURSE: \$1.5 Million

Autonomous robot  
Easily identified samples  
Terrain maps provided but  
no use of GPS

*To encourage innovations in  
robotic navigation and sample  
manipulation technologies*



July 13, 2010

[www.nasa.gov/oct](http://www.nasa.gov/oct)  
16

# Centennial Challenges Summary



Participatory Research & Development  
with Opportunities for:

## **Competitors**

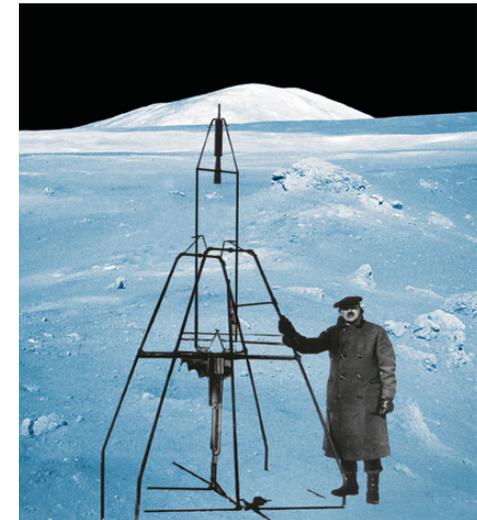
*entrepreneurs & other businesses,  
inventors, students*

## **Allied Organizations**

*private organizations*

and **Sponsors for Allied Organizations and Teams**

*businesses, organizations, individuals*



**STRONG TETHER  
POWER BEAMING  
GREEN FLIGHT**

**NANO-SAT LAUNCH  
NIGHT ROVER  
SAMPLE RETURN ROBOT**