



JOHNSON SPACE CENTER

*Yolanda Marshall
NASA Johnson Space Center
August 16, 2018*

Earth

Moon

Mars



Commercial launch
Vehicles



Orion



SLS



Commercial Lunar
Lander



Robotic Surface
Missions



Lunar Orbital Platform - Gateway
PPE- Habitat - Airlock - Logistics



Mars robotic exploration,
technology development

In LEO

Commercial & International
partnerships

In Cislunar Space

A return to the moon for
long-term exploration

On Mars

Research to inform future
crewed missions

Key drivers for NASA's Partnerships

Goal: Insuring each relationship creates a win-win between industry goals and NASA's mission

Co-Development	Technology Infusion	Technology Transfer	Sharing our message
▪ Create opportunities for Industry and NASA to advance technology to enable shared goals ▪ Seeking partners across 6 industries ▪ Energy ▪ Medical ▪ Advanced Manufacturing ▪ Agribusiness ▪ Maritime ▪ Aerospace	▪ Fostering an environment where Industry technologies can be spun-in to support NASA technology challenges ▪ Platforms provided where industry can accelerate their technology or where the wisdom of the crowd (industry & Community) can advance the state of the art of technology	▪ Impact created across industry from the technology licensed from NASA ▪ Streamlined interface to facilitate industry finding NASA technology to license ▪ Startup NASA enables entrepreneurs to create new companies from NASA technology	▪ Inspiring the next generation of explorers ▪ Partnering with Educators to inspire students to pursue STEM careers ▪ Increase reach of NASA's message of creating the future to all grade levels and to the general public
CREATE	FOSTER	IMPACT	INSPIRE

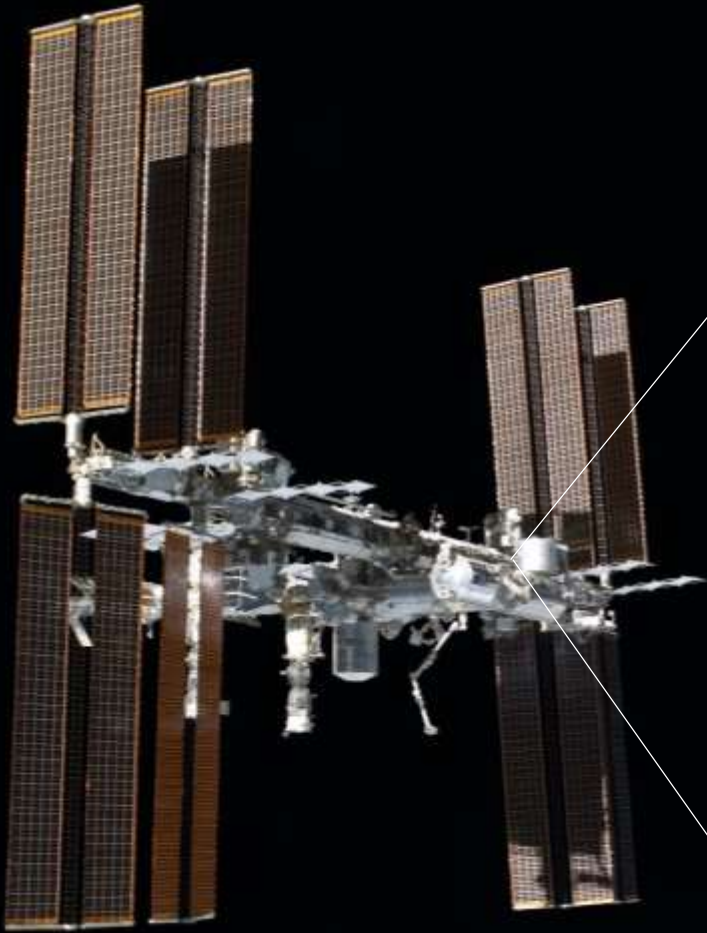


Lead Human Space Flight

EXPEDITION 56

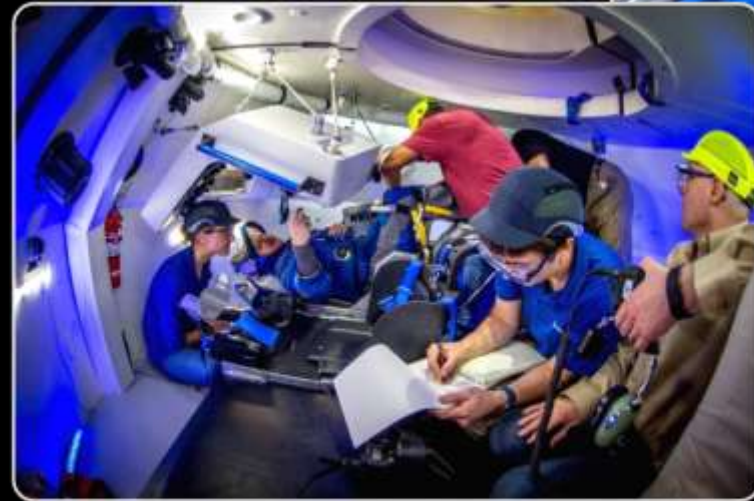


A NATIONAL LABORATORY



Commercial Crew Program

Veteran astronauts work side-by-side with Boeing and SpaceX providing **human in-the-loop insight** and **best practices** learned from flying in space on a variety of spacecraft and launch vehicles.



Moving *Forward*

We are moving forward on the final development and certification of *two* safe, reliable and cost-effective, American-made crew transportation systems



DEEP SPACE EXPLORATION

Deep space exploration is the means to extend human presence beyond low Earth orbit into cislunar space, to the Moon, and on to Mars. We seek answers to fundamental questions about the origins and dynamics of our solar system, the availability of resources, opportunities for human habitation, and even our human destiny beyond Earth.

JSC leads the way to deep space by integrating Science and engineering to develop...

JSC Technology Focus Area

- Environmental Control & Life Support
Spacesuits
Space Radiation Protection
Robotics and Autonomous Systems
- Entry, Descent, & Landing
In-Situ Resource Utilization
Human System Research

...how we *travel* to get out there

- Spaceflight Architecture
- Mission Planning
- Surface Systems



...how we *work* out there

- Spacesuits
- Surface Operations
- Training in Mission-Relevant Environments



...how we *explore* out there

- Science in Cislunar Space and on Planets, Moons, and Asteroids



JSC is home to NASA Astromaterials and a leader in planetary science



... and how we *live* out there

- Deep Space Habitats
- Human Health & Performance
- In-Situ Resource Utilization



NASA is partnering with private industry to develop deep space habitation concepts





Develop
Technology to
Solve Problems

Industry and NASA Advance Technology Together



Advanced Manufacturing



Advanced Technologies



Agriculture



Energy



Life Sciences / Human Performance



Maritime



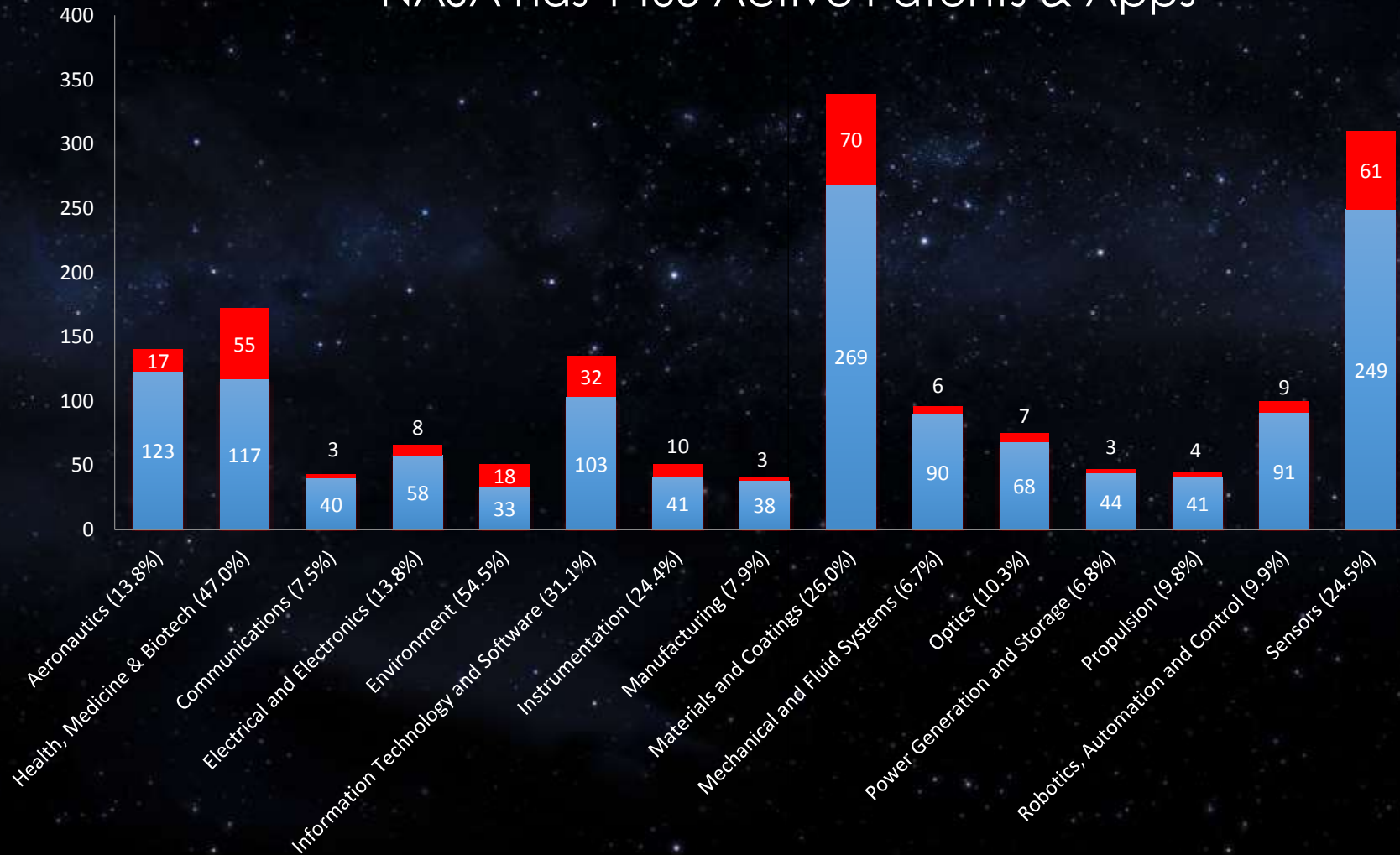
Transportation and Logistics

NASA's Patent Portfolio

"Bringing NASA Technology Down to Earth"



NASA has 1 405 Active Patents & Apps





For a full listing of available NASA patents and patent applications available for licensing, visit <http://technology.nasa.gov/patents>



For free access to over 1,000
NASA software programs, visit
<http://software.nasa.gov>



business systems and
project management



data servers processing
and handling



materials and
processes



system testing



propulsion



electronics and
electrical power



operations



structures and
mechanisms



environmental
science



design and
integration tools



crew and life
support



autonomous
systems



vehicle
management



data and image
processing



aeronautics



Chlorophyll Meters Aid Plant Nutrient Management

Licensed NASA technology developed from satellite sensors now forms the basis for a hand-held chlorophyll meter. Growers and agricultural researchers use the meter to determine the nutrient needs of crops such as wheat, rice, cotton, and corn. The meter reveals indications of disease 2 weeks before visible signs appear.



LED Systems Target Plant Growth

To help develop technologies for growing food crops in space, one company invented a lighting system, now used in agricultural greenhouses, that can be adapted to allow maximum efficiency in light absorption by all available photosynthetic tissues.



Aeroponic Gardens Help Plants Grow Faster and Healthier

A soil-less plant-growth experiment that enabled plants to grow healthy without the use of pesticides has enabled the development of a commercial aeroponic system. The sterile environment allows plants to grow disease-free, with 98 percent less water, and no pesticides.



Toolkits Control Robotics for Fruit Harvesting

With NASA funding, a company developed design and control software that enables the effective operation of robots, including a robotic system for citrus fruit harvesting. The system has multiple cameras and disposable picking mechanisms to mass harvest fruit for juice processing.



Remote Sensing Influences Crop Services for Farmers

NASA's geospatial satellite information assisted in the creation of a crop prescription service that allows farmers to generate prescriptions and crop scouting maps. It also contributed to the development of an educational service for young farmers to familiarize them with geospatial technology.



Navigation System Drives Automated Tractor Steering

NASA's Gravity Probe B program led to a surprising outcome: a GPS auto-steering technology for guiding automated agricultural equipment. The technology helps farmers reduce fuel costs, decrease driver fatigue, and eliminate overlap on fields.



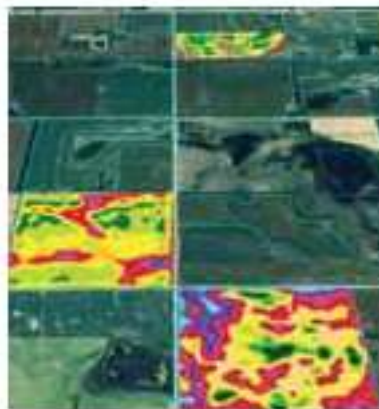
Image Processing Software Informs Farming Practices

NASA's Earth Resources Laboratory Applications software was adapted and used in a program to provide data for prescription farming. Data about soil content and rainfall levels informs farmers' decisions about soil nutrient additives, irrigation, and pest control.



Feature Detection Systems Enable Maps of Crop Fields

NASA SBIR contracts supported the development of satellite image refinement software that helps researchers study the effects of population and climate on crop field acreage. The system produces detailed maps of crop fields, which can provide useful information on agricultural production.



Data Delivery Methods Enhance Satellite Images for Agriculture

When a company wanted to improve its technology for analyzing satellite imagery of farmland and agricultural fields, it turned to NASA. Today, the company provides imagery and data analysis for agri-business and the crop insurance industry.



Air Purifiers Eliminate Pathogens, Preserve Produce

NASA researchers developed a technology that removes a chemical from the air responsible for speeding the decay of fruits and vegetables. Today, the device helps preserve produce on its way to and at the market, helping farmers protect their harvests at an operating cost as little as \$1 a day.



Tools for Partnering



- ⌘ Communities of Practice
- ⌘ Interagency Agreements
- ⌘ Space Act Agreements
- ⌘ Licensing Technologies

- ⌘ International Agreements
- ⌘ Cooperative R&D Agreements
- ⌘ Software Use Agreements

