



Advancing Technology Capabilities for Human Exploration

Sam Gunderson

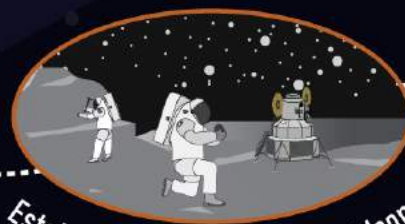
Overview of the Exploration Technology Office

Exploration EVA Technology Workshop

October 14, 2021



Continue EVA Advancement on ISS



Establish EVA Presence on the Moon



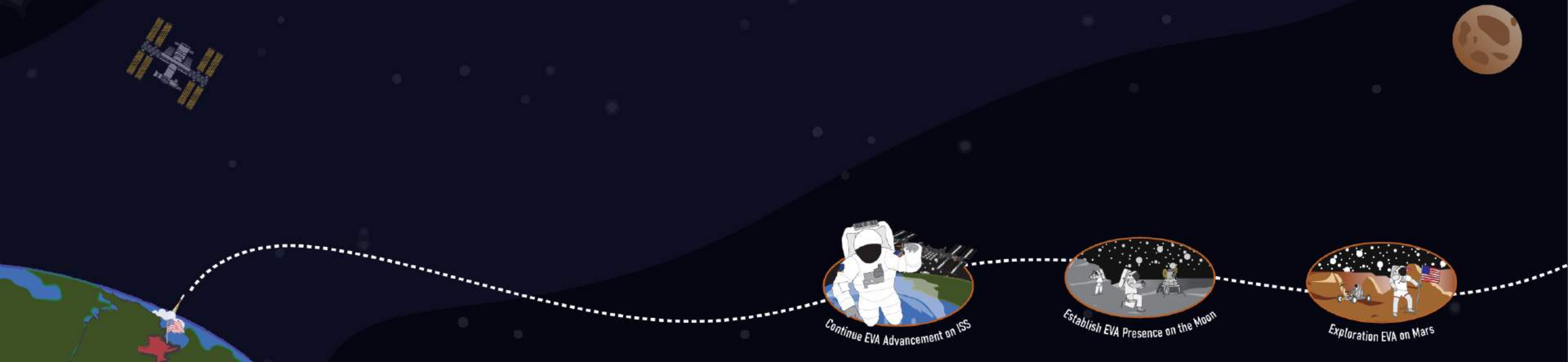
Exploration EVA on Mars

EXPLORATION TECHNOLOGY OFFICE



As NASA embarks on its next era of exploration, the Exploration Technology Office is focused on advancing technologies and partnerships to develop new capabilities for human exploration.

The Exploration Technology Office oversees technology development, technology transfer and partnerships to support the Johnson Space Center and the NASA mission.



TECHNOLOGY DEVELOPMENT

Develops & leads the execution of the JSC Technology Strategy focused on technology development goals that enable deep space exploration.

Advances TRLs and reduces risk for integration in critical NASA missions.

Manages the JSC technology priorities and integrated technology portfolio to ensure technical maturation is in alignment with center priorities, critical partnerships, and estimates of capabilities for future needs.

PARTNERSHIPS

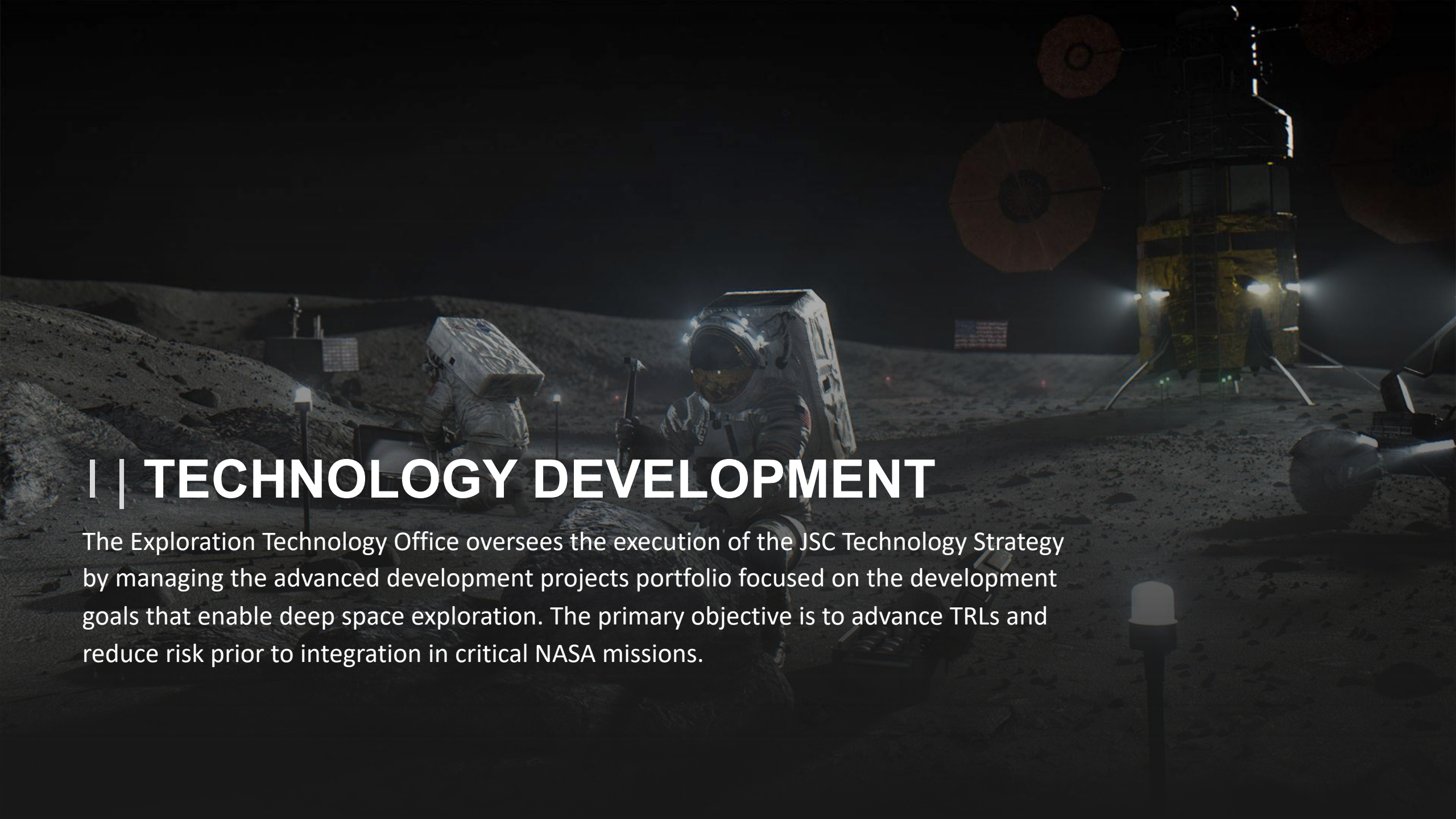
Partners with industry and academia to create products/services that meet NASA and industry needs.

Provides a simple and responsive process for industry to work with NASA in support of US Government proposals.

TECHNOLOGY TRANSFER

Manages the JSC intellectual property portfolio, ensuring that innovations developed for exploration and discovery are broadly available to the public, maximizing the benefit to the Nation, including:

- New Technology Reporting
- Software Release Administration
- Technology Licensing
- Patent Portfolio Administration
- Partnership Development Support
- Intellectual Property Portfolio

A detailed illustration of a lunar surface at night. Two astronauts in white spacesuits are working on the ground. One astronaut is in the foreground, holding a tool, while the other is further back. A large, gold-colored lunar lander with solar panels is visible in the background, illuminated by its own lights. The surface is covered in craters and rocks, and the sky is dark.

I | TECHNOLOGY DEVELOPMENT

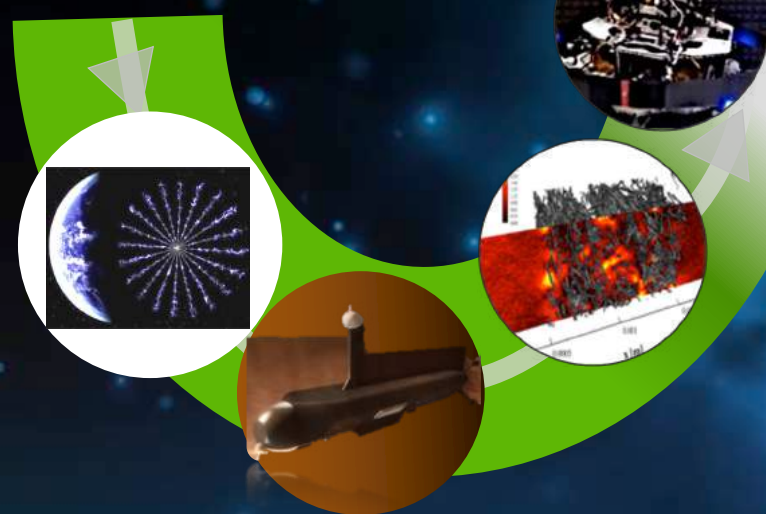
The Exploration Technology Office oversees the execution of the JSC Technology Strategy by managing the advanced development projects portfolio focused on the development goals that enable deep space exploration. The primary objective is to advance TRLs and reduce risk prior to integration in critical NASA missions.

TECHNOLOGY PIPELINE

Early Stage

- NASA Innovative Advanced Concepts
- Space Tech Research Grants
- Center Innovation Fund

Low TRL



Mid TRL

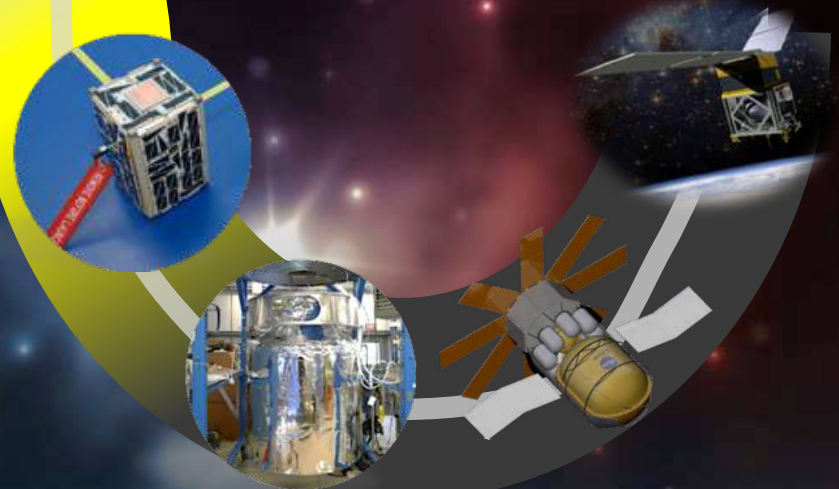
Game Changing Development



Commercial Partnerships

- SBIR /STTR
- Flight Opportunities
- Centennial Challenges
- Regional Economic Development

High TRL



Technology Demonstration Missions

JSC TECHNOLOGY FOCUS AREAS



ENVIRONMENTAL CONTROL & LIFE SUPPORT

Primary focus is in closing the life support loop
Water, air, and waste
Working on water extraction from brine
Improvements in reliability, and maintainability
Waste management – recycling, repurposing

ROBOTICS AND AUTONOMOUS SYSTEMS

Autonomous management of logistic resupply
S/C health monitoring, data synthesis, and informed assistance to crew and ground control
Tracking of inventory on board
Rovers
Manipulation systems

HUMAN SYSTEM RESEARCH

Human physiology research and impacts of extreme environment – bone, muscle, sensorimotor, nutrition, immunology, medicine, performance, toxicology, microbiology
Radiation impacts on immunology, carcinogenesis, tissue, and pharmaceutical stability
Autonomous medical systems
Food
Psychology of isolation – human behavior and performance

SPACESUITS & EVA SYSTEMS

Mass reduction technology
Suitport system implementation (PLSS packaging, docking/seal systems, dust mitigation)
Informatics (navigation, lighting, radiation)
Vacuum/partial atmosphere systems (CO2 removal, thermal management)

ENTRY, DESCENT & LANDING

Entry G&NC
Large rigid systems
Integration of structures and heatshield
Ablative systems
Advanced manufacturing and automation of heatshield production
Ablation modeling

ADVANCED DEVELOPMENT PRIORITIES

Dust
Informatics
ISRU
Docking
Exploration Medical

SPACE RADIATION

Modeling of system
Crew health mitigation strategies
Radiation protection
Active/passive radiation detection and shielding

IN-SITU RESOURCE UTILIZATION

Lunar regolith water and oxygen extraction
Integration with ECLSS, Power, and Propulsion systems in terms of common fluids
Ablation modeling



SBIR/STTR PROGRAM

<https://sbir.nasa.gov/>

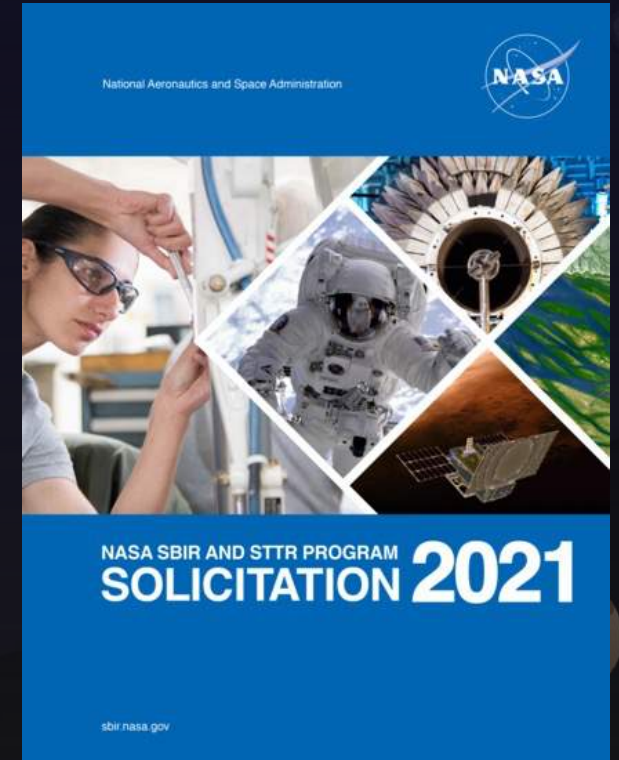
The NASA SBIR and STTR programs fund the research, development, and demonstration of innovative technologies that fulfill NASA needs as described in the annual Solicitations and have significant potential for successful commercialization.

Small Business Innovation Research (SBIR)

- A program for small business to engage in Federal R&D – with potential for commercialization
- The goal is to empower small businesses to deliver technological innovation that contributes to NASA's missions, provides societal benefit, and grows the US economy
- Currently, 3.2% of Federal agencies Extramural R&D budgets greater than \$100M per year

Small Business Technology Transfer (STTR)

- A sister program to facilitate cooperative R&D between small business concerns and U.S. research institutions – with potential for commercialization
- Currently, 0.45% of the extramural research budget for all agencies with a budget greater than \$1B per year



SBIR/STTR PROCESS

<https://sbir.nasa.gov/>



Mature

Mature transformative future aerospace capabilities to address known revolutionary knowledge & technology gaps through small businesses & research institutions.

1



Accelerate

Accelerate small business technology development to address specific high priority nearer term NASA knowledge, technology & development gaps & infuse those technologies to known buyers & end users.

2



Shape

Shape & leverage an engaged, possibility-expanding ecosystem to increase productivity, improve competitive edge & grow markets for the US Aerospace industry.

3

The program also has other vehicles to support “Accelerate” such as CCRPP, etc.



SBIR/STTR OPPORTUNITIES

<https://sbir.nasa.gov/>



SBIR/STTR TOPIC AREAS

<https://sbir.nasa.gov/>



JSC-related SBIR Topics (2021)

- H3 Habitation Systems
- H4 Extra-Vehicular Activity (EVA)
- H8 ISS Utilization and Microgravity Research
- H12 Human Research and Health Maintenance
- Z2 Spacecraft and Platform Subsystems
- Z5 Robotic Systems for Space Exploration
- Z12 Technologies to Enable the In-space Economy
- Z13 Dust Mitigation

JSC-related STTR Sub-Topics (2021)

- T6.06 Enabling Spacecraft Water Monitoring Through Nanotechnology
- T6.07 Space Exploration Plant Growth
- T9.02 Rapid Development of Advanced High-Speed Aerosciences Simulation Capability
- T10.04 Autonomous Systems and Operations for the Lunar Orbital Platform – Gateway
- T11.04 Digital Assistants for Science and Engineering
- T12.05 Use of Additive Manufacturing for Thermal Protection Systems
- T14.01 Advanced Concepts for Lunar and Martian Propellant Production, Storage, Transfer, and Usage



A close-up photograph of two white astronaut gloves reaching towards each other in a dark, starry space environment. The gloves are positioned on the left and right sides of the frame, with their fingers slightly curled as if about to grasp or shake hands. The background is a deep blue and black, filled with out-of-focus stars and the faint, hazy outlines of celestial bodies, creating a sense of vastness and isolation.

II | PARTNERSHIPS

The Exploration Technology Office facilitates the development of agreements, collaborations and alliances with commercial, international, and academic entities, as well as other government agencies and entrepreneurial communities, recognizing them as important contributors of skill and creativity to NASA. These partnerships help achieve NASA strategic technological goals and improve U.S. competitiveness, economic growth, and quality of life.

JSC PARTNERSHIP OBJECTIVES



- Partner with industry and academia using public/private partnerships to create products/services that meet NASA and industry needs
 - Balance industry needs and NASA partnership roles to manage program risk and reduce lifecycle costs
 - Earlier engagement provides opportunity to build trust and have meaningful conversations that leads to valued relationships
- Provide simple and responsive process for industry to work with NASA in support of US Government proposals
- Use Technology Programs, Technology Transfer and SAAs to develop trusted relationships to support industry needs
- Work with stakeholders to provide JSC competencies – people, processes, tools, and facilities to support product development and community/STEM needs



EARLY ENGAGEMENT



JSC wants to engage industry as early as possible in this process to provide timely solutions to industry needs – draft GTAs

Our objective is to listen to industry needs/risks and provide awareness into JSC's capabilities that could meet their needs

Offerors have time to balance the capabilities of their industry team and NASA to create their proposal

NASA does not want to be in the critical path of system development or delivery of subsystems but to provide guidance and support





III | TECHNOLOGY TRANSFER (T2)

The Exploration Technology Office manages the JSC intellectual property portfolio to facilitate the commercialization of NASA-sponsored research and technology and provide strong assistance to entrepreneurs, companies, and investors to bring NASA technologies to the marketplace.

TECHNOLOGY TRANSFER OBJECTIVES



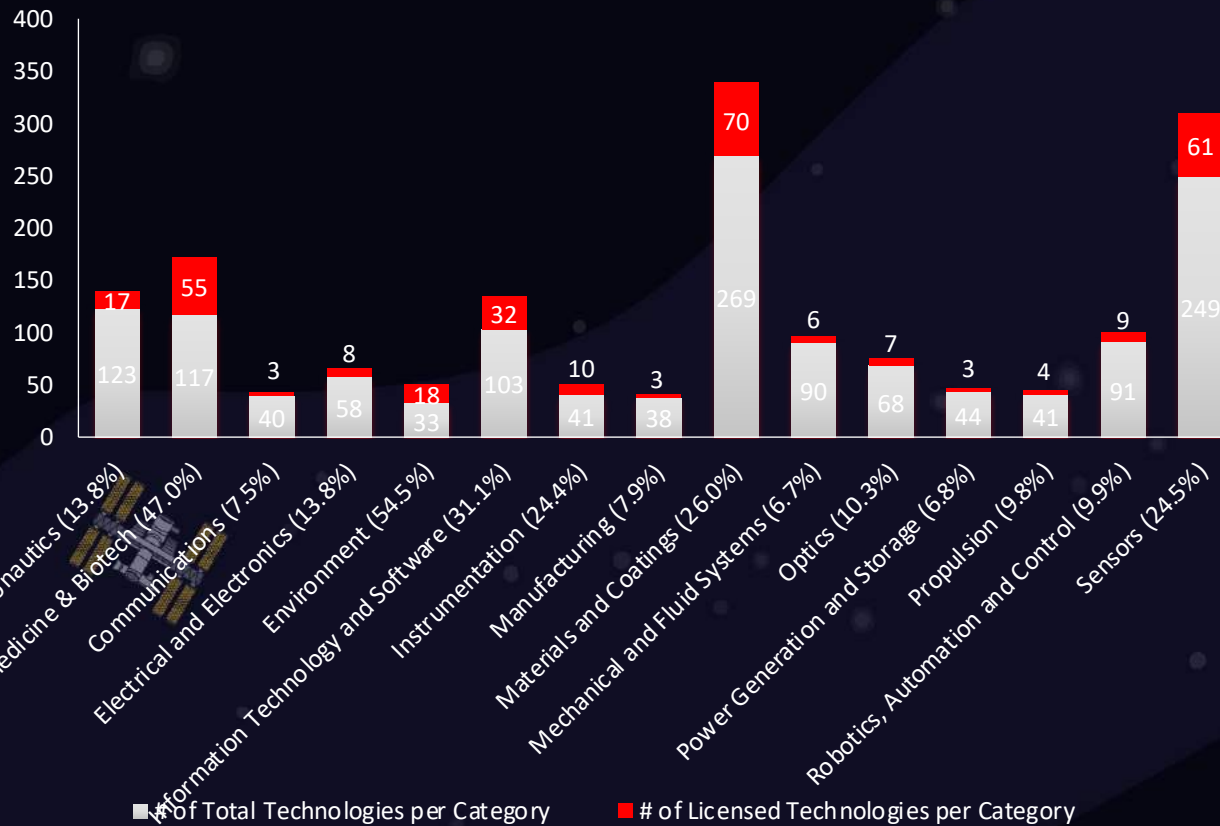
- Transfer NASA generated technology for commercialization in order to
 - Benefit life on earth
 - Support economic growth and vitality
- Work to enable the success of the commercial space industry
- Engage with academia to cultivate entrepreneurship opportunities based on NASA technologies and innovations



PATENT PORTFOLIO

“Untapped potential to seed more space commerce startups”

<http://technology.nasa.gov/patents>



NASA has over 1,200 Active Patents



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TECHNOLOGY LICENSING



NASA develops all sorts of technology to solve the tough challenges of exploring space, advancing the understanding of our home planet, and improving air transportation. Often, those same inventions have other untapped applications. Through patent licensing, those technologies can be transformed into commercial products and solutions that can give your business that competitive edge.

Step 1: Find a Technology – NASA's patent portfolio contains more than 1,200 technologies that have been organized into categories and made searchable so you can easily identify technologies suited for your business needs.

Step 2: Apply for a Technology License - With the click of a button, you can begin the online application process using NASA's Automated Technology Licensing Application System (ATLAS).

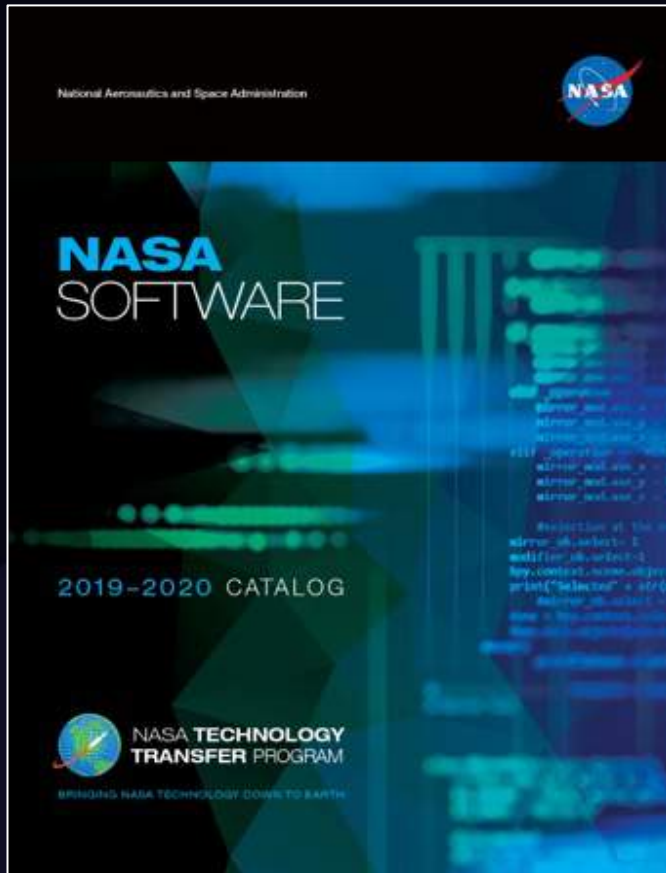
Step 3: Set Terms for the Agreement - After submitting your license application, the terms of the agreement are worked out by you and the NASA license manager.

Step 4: Sign the License - When terms for the license are set, NASA and the company execute the license under the terms of the agreement.



SOFTWARE RELEASE

<http://software.nasa.gov>



NASA's Software Catalog offers hundreds of new software programs you can download for free to use in a wide variety of technical applications.

Most software release requests will be processed within 5 business days.



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SOFTWARE RELEASE



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



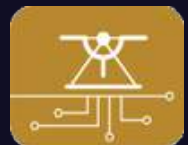
design and integration tools



crew and life support



autonomous systems



vehicle management



data and image processing



aeronautics

The NASA software catalog is organized into 15 different technical categories.

Each code is designated with a release type which determines who can have a NASA software code. If you meet the access criteria for the code (as defined below), NASA can transfer the software to you.

- **General Public:** For codes with a broad release and no nondisclosure or export control restrictions
- **Open Source:** For collaborative efforts in which programmers improve upon codes originally developed by NASA and share the changes
- **U.S. Release Only:** For codes available to U.S. persons only
- **U.S. and Foreign:** For codes that are available to U.S. persons and persons outside of the U.S. (who meet certain export control restrictions)
- **U.S. Government Purpose:** For codes that are to be used on behalf of the U.S. government by a federal agency or business/university under a federal contract/grant/agreement



NASA SPINOFFS

<http://spinoff.nasa.gov>



Consumer/Home/
Recreation



Computer
Technology



Health & Medicine



Environment and
Resource Management



Public Safety



Transportation

With nearly **2,000** recorded NASA spinoffs, NASA technologies influence our lives in a variety of ways—making us safer, healthier, and more efficient.



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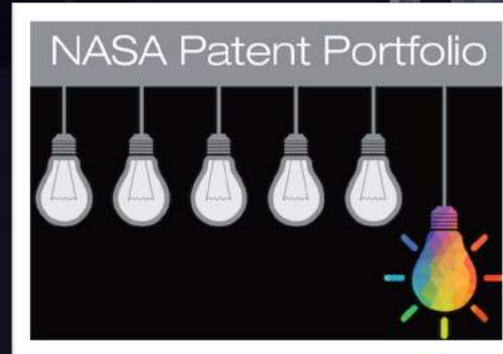


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MORE INFORMATION



View JSC Capabilities and Partnering Opportunities
<https://www.nasa.gov/johnson/exploration/technology>



View Patents and License NASA Technology
<https://technology.nasa.gov/license>



Learn more about the SBIR/STTR Program
<https://sbir.nasa.gov/>



View and Download NASA Software
<https://software.nasa.gov/>





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