National Aeronautics and
Space Administration

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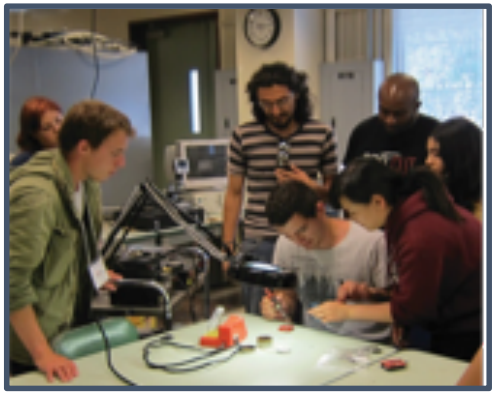
The Next Generation of Explorers


NASA Advisory Council STEM Engagement Committee

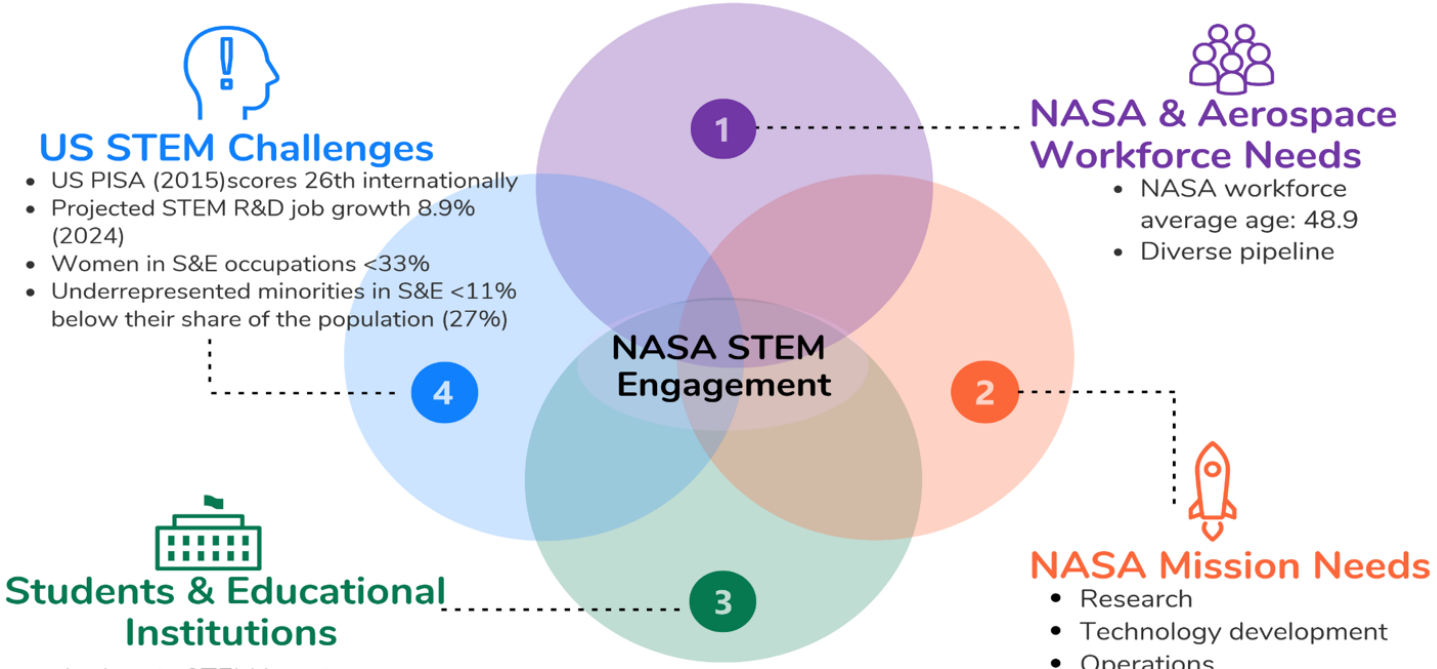
Office of STEM Engagement Update

October 29, 2019

Mike Kincaid
Associate Administrator for STEM Engagement

Kris Brown
Deputy Associate Administrator for STEM Engagement

NASA'S CONTRIBUTIONS TO AMERICA'S STEM ECOSYSTEM



NSF Science and Engineering Indicators Report (2015)

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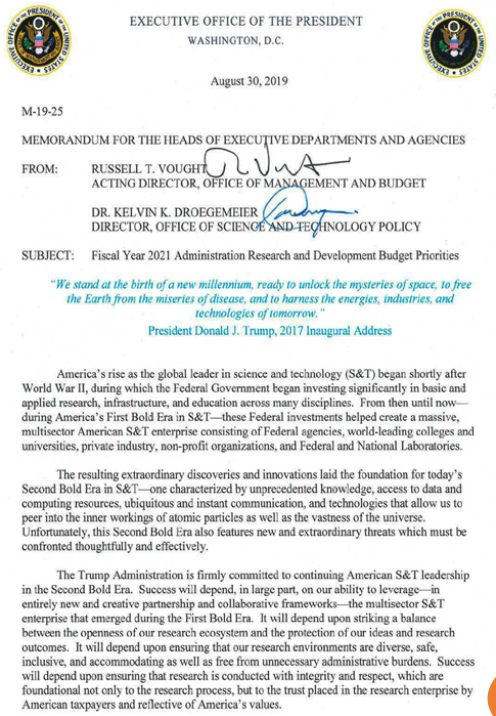
NASA's Alignment with OSTP/OMB Priorities



EXECUTIVE OFFICE OF THE PRESIDENT
WASHINGTON, D.C.

August 30, 2019

M-19-25

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: RUSSELL T. VOUGHT
ACTING DIRECTOR, OFFICE OF MANAGEMENT AND BUDGET

DR. KELVIN K. DROEGEMEIER
DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY

SUBJECT: Fiscal Year 2021 Administration Research and Development Budget Priorities

"We stand at the birth of a new millennium, ready to unlock the mysteries of space, to free the Earth from the miseries of disease, and to harness the energies, industries, and technologies of tomorrow."
President Donald J. Trump, 2017 Inaugural Address

America's rise as the global leader in science and technology (S&T) began shortly after World War II, during which the Federal Government began investing significantly in basic and applied research, infrastructure, and education across many disciplines. From then until now—during America's First Bold Era in S&T—these Federal investments helped create a massive, multisector American S&T enterprise consisting of Federal agencies, world-leading colleges and universities, private industry, non-profit organizations, and Federal and National Laboratories.

The resulting extraordinary discoveries and innovations laid the foundation for today's Second Bold Era in S&T—one characterized by unprecedented knowledge, access to data and computing resources, ubiquitous and instant communication, and technologies that allow us to peer into the inner workings of atomic particles as well as the vastness of the universe. Unfortunately, this Second Bold Era also features new and extraordinary threats which must be confronted thoughtfully and effectively.

The Trump Administration is firmly committed to continuing American S&T leadership in the Second Bold Era. Success will depend, in large part, on our ability to leverage—in entirely new and creative partnership and collaborative frameworks—the multisector S&T enterprise that emerged during the First Bold Era. It will depend upon striking a balance between the openness of our research ecosystem and the protection of our ideas and research outcomes. It will depend upon ensuring that our research environments are diverse, safe, inclusive, and accommodating as well as free from unnecessary administrative burdens. Success will depend upon ensuring that research is conducted with integrity and respect, which are foundational not only to the research process, but to the trust placed in the research enterprise by American taxpayers and reflective of America's values.

**OSTP/OMB*

OSTP/OMB R&D Priorities

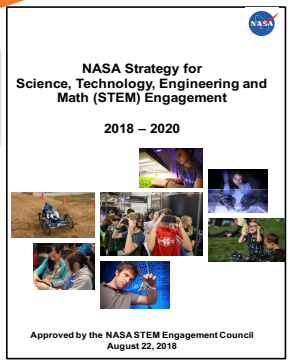
1. Security
2. Leadership in Industries of the Future
3. Energy and Environmental Leadership
4. Health and Bioeconomic Innovation
5. Space Exploration and Commercialization

Priority Cross-Cutting Actions

1. Build and Leverage a Diverse, Highly Skilled American Workforce
2. Create and Support Research Environments that Reflect American Values
3. Support Transformative Research of High Risk and Potentially High Reward
4. Leverage the Power of Data
5. Build, Strengthen, and Expand Strategic Multisector Partnerships

NASA STEM Engagement Strategy Focus Areas

1. Create unique opportunities for students to contribute to NASA's work
2. Build and Leverage a Diverse, Highly Skilled American Workforce
3. Strengthen understanding of STEM by enabling powerful connections to NASA's mission and work



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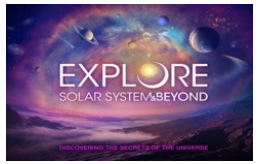
Architecture Enabling Student Opportunities & Contributions

NASA Mission Directorate Drivers & Requirements



Evidence-based strategies

Rigorous planning

Integrated operational model

Focus Areas

Create unique opportunities for students to contribute to NASA's work.

Build a diverse future STEM workforce by engaging students in authentic learning experiences.

Strengthen understanding of STEM by enabling powerful connections to NASA's mission and work.

Strategic, balanced portfolio

NASA-unique learning experiences

Student contributions to NASA's work in action

Scalability to Magnify NASA's Reach and Impact

Beneficiaries of NASA's STEM Engagement Portfolio

K-Elementary School

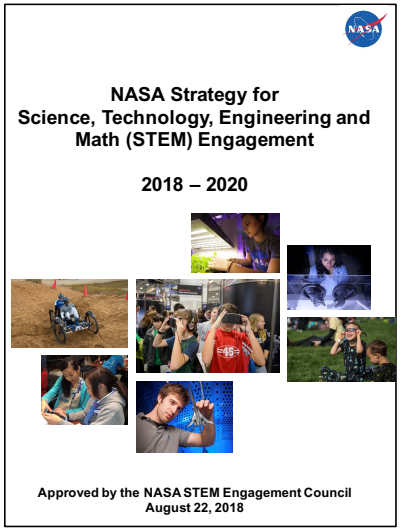
Middle School

High School

Undergraduate

Graduate

NASA Strategy for STEM Engagement



Focus Areas

Objectives

Create unique opportunities for students to contribute to NASA's work

- 1.1 Students contribute to NASA's endeavors in exploration and discovery.
- 1.2 Research and development capacity of educational institutions is enhanced, enabling broad and diverse contributions that directly address NASA priorities.

Build a diverse, skilled, future STEM workforce

- 2.1 Broad and diverse set of students are attracted to STEM through NASA opportunities.
- 2.2 Students, including underrepresented and underserved communities, explore and pursue STEM pathways through authentic learning experiences and research opportunities with NASA's people and work.
- 2.3 The portfolio of NASA STEM engagement opportunities meets Agency workforce requirements and serves the nation's aerospace and relevant STEM needs.
- 2.4 Strategic partnerships with industry, academia, non-profit organizations and educational institutions enhance and extend the impact of NASA's efforts in STEM engagement.

Strengthen understanding of STEM by enabling powerful connections to NASA's mission

- 3.1 Youth are introduced to STEM concepts and content through readily available NASA STEM engagement resources and content.
- 3.2 Students gain exposure to STEM careers through direct and virtual experiences with NASA's people and work.

NASA STEM Engagement Portfolio - Drivers & Contributions

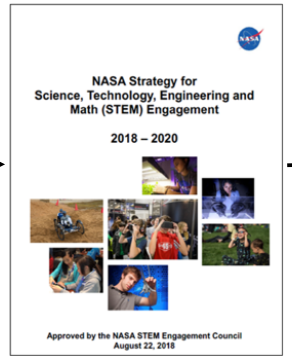
Student contributions to NASA's work in action

Mission Goals, Needs and Requirements

Mission Activities

STEM Practitioners

NASA · Industry · Academia



STEM Engagement Goals and Requirements

STEM Engagement Activities

Students

NASA STEM Engagement Portfolio

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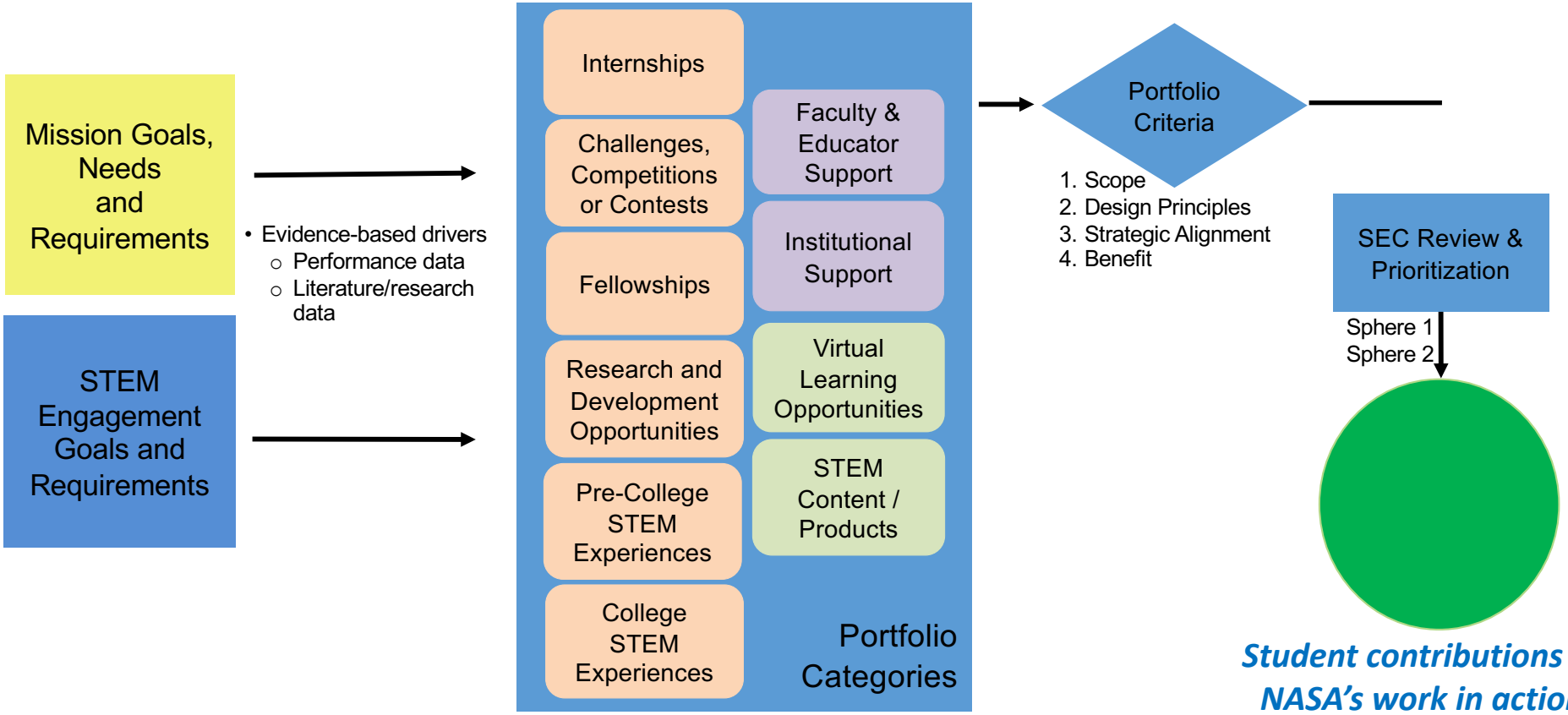
STEM Engagement Annual Planning Cycle



NASA STEM Engagement Portfolio Snapshot

Strategy Alignment and Analysis

Activity Type	TOTAL	Beneficiaries					1. Enabling Contributions					2. Building a Diverse Workforce						3. Strengthen Understanding			
		Elem	Middle	High	Undergrad	Grad	1.1a	1.1b	1.1c	1.2a	1.2b	2.1a	2.1b	2.2a	2.2b	2.3a	2.4a	3.1a	3.1b	3.1c	3.2a
Internships	11			•	•	•	•	•	•			•	•	•	•	•	•				•
Challenges, Comp. & Contests	24	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Fellowships	4		•	•	•		•	•	•	•	•	•	•	•	•		•	•			•
R&D Opportunities	11			•	•		•	•	•	•	•	•	•	•	•		•	•	•	•	•
Pre-College STEM Experiences	12	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
College STEM Experiences	5			•	•		•	•	•	•	•	•	•	•	•		•	•		•	•
STEM Content & Products	11	•	•	•	•			•	•	•	•	•	•	•	•		•	•		•	•
Virtual Learning Opportunity	0																				
Institutional Support	7	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•
Faculty & Educator Support	9	•	•	•	•	•	•	•	•	•	•	•	•		•		•	•	•	•	•

Total Activities: 94

NASA STEM Engagement Portfolio Snapshot
Contributions by Organization

Types of Activities	ARMD	HEOMD	SMD	STMD	OSTEM	*Other	Totals
Internships		2	5		4		11
Challenges, Competitions & Contests	2	11	4	4	2	1	24
Fellowships	1			1	2		4
R&D Opportunities			2		9		11
Pre-College STEM Experiences		3	2		7		12
College STEM Experiences				1	4		5
STEM Content & Products	5			1	5		11
Virtual Learning Opportunity							
Institutional Support			2	1	4		7
Faculty & Educator Support			2	1	6		9
Total:	**8**	**16**	**17**	**9**	**43**	**1**	**94**

*Note: Supported by Center-Based or other Functional Offices

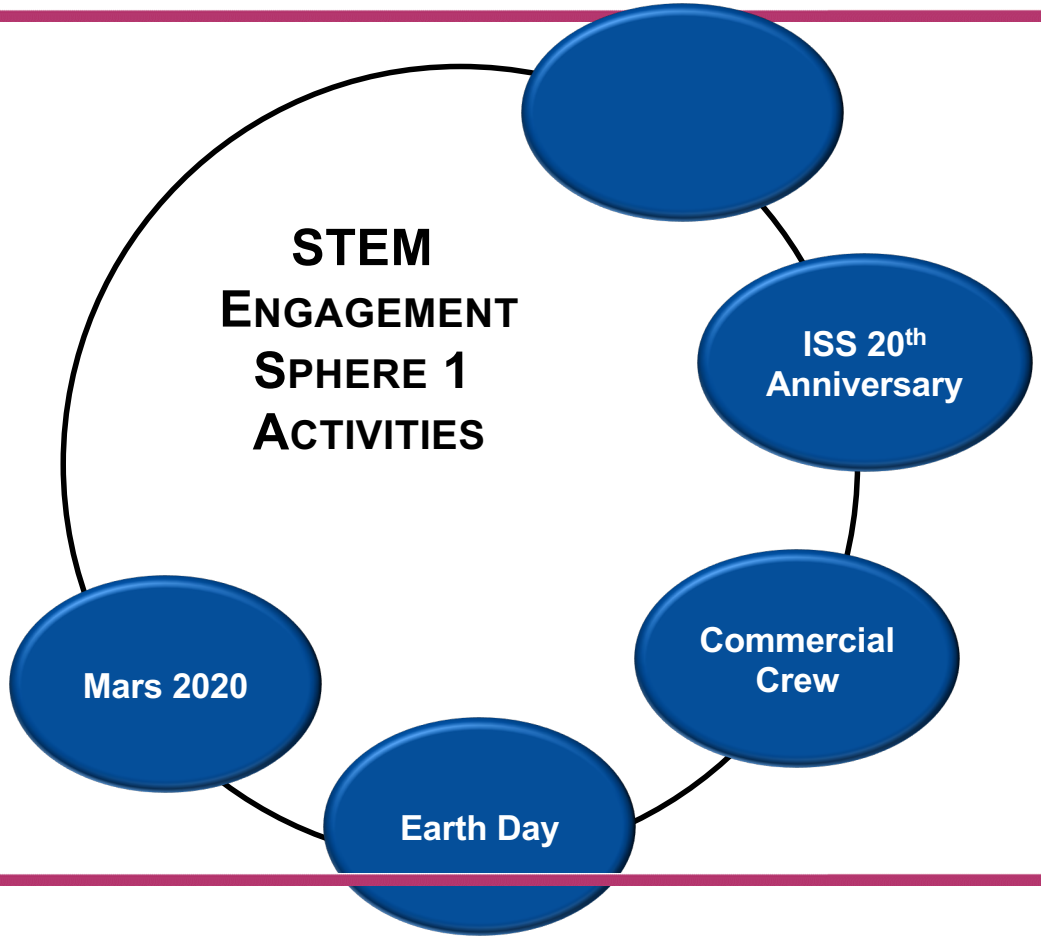
STEM Engagement Portfolio Design Principles and Criteria

Criteria	STEM Engagement Implications
1. Scope	STEM Engagement includes all of NASA's efforts to attract, engage and educate students and support educators and institutions.
2. Design Principles	Activities must be mission-driven authentic STEM experiences. Activities do not have to integrate all four design principles, but they should incorporate as many as possible.
3. Alignment	Demonstrates direct alignment and contributions to the NASA Strategy for STEM Engagement objectives and strategies and the NASA Strategic Plan.
4. Benefits	Has a direct or indirect benefit to students.

Design Principles	Definition
Mission-driven authentic STEM experiences	Experiential opportunities, design and development activities, research experiences, and/or products that contribute to NASA's endeavors in exploration and discovery and help solve problems and address needs and priorities that are critical to NASA's mission.
Evidence-based practices	Guidelines, strategies, frameworks, and promising practices informed by research, literature reviews, and/or evaluation to build the available body of facts (evidence) confirming program effectiveness and impact.
Diversity and inclusion	Infuse objectives and target strategies, where practicable, to attract and sustain diversity in student participation, and to incorporate approaches to foster and promote inclusion.
Scalability through partnerships and networks	Incorporate in the design of an activity or product, where appropriate, attributes and characteristics that provide opportunities to leverage partnerships and networks in order to magnify reach and impact

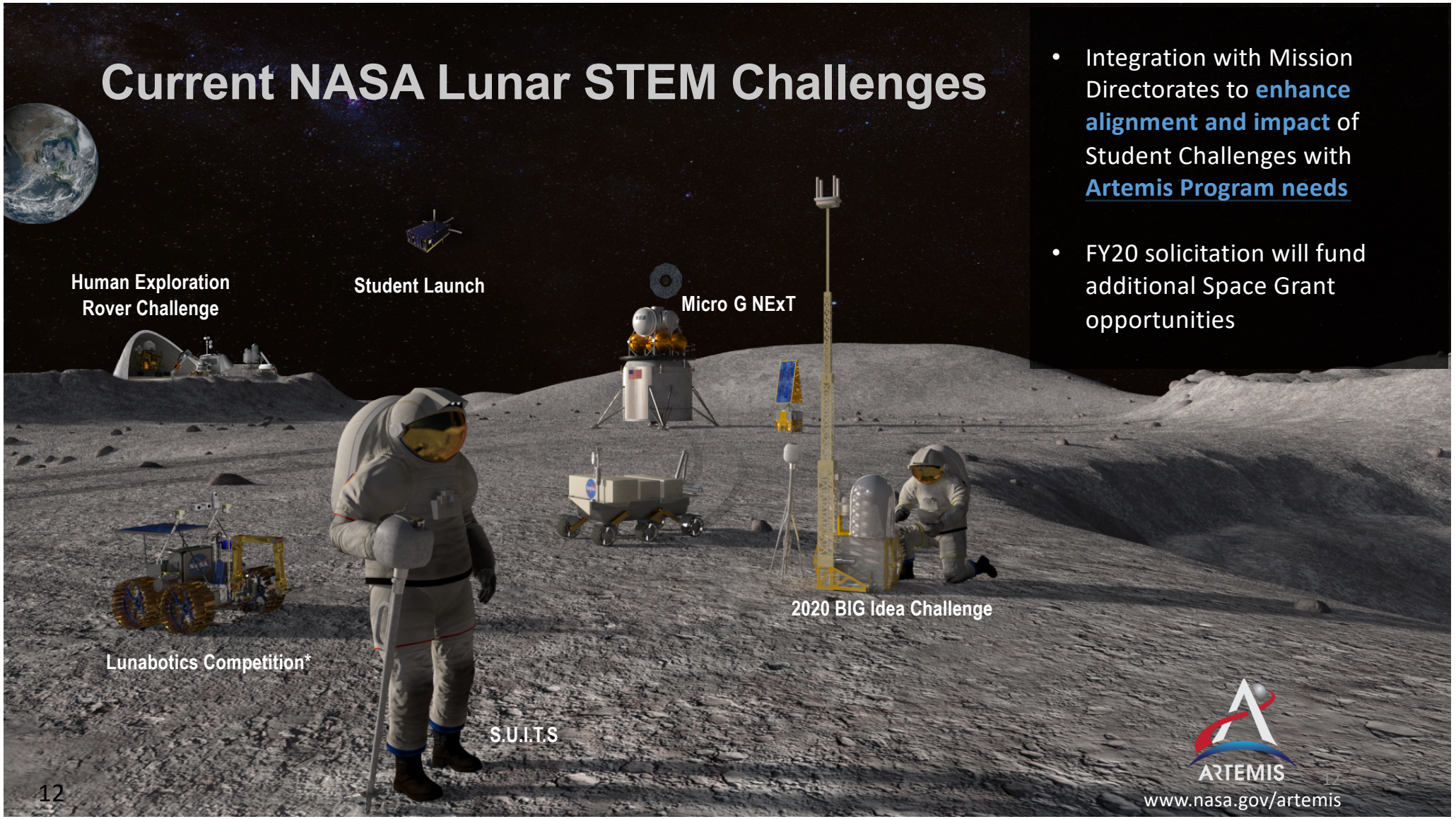
*SEC Member Concurrence April 2019

FY2020 STEM Engagement Sphere 1 Activities



Approved by the STEM Engagement Council
October 16, 2019

Current NASA Lunar STEM Challenges



- Integration with Mission Directorates to **enhance alignment and impact** of Student Challenges with **Artemis Program needs**
- FY20 solicitation will fund additional Space Grant opportunities

ARTEMIS
www.nasa.gov/artemis

Commercial Crew

- Students and educators **embrace the importance** of achieving safe, reliable and cost-effective access to low-Earth orbit.
- Develop and deploy an evidence-based toolkit of resources and content for educators and students that includes **engineering challenges, coding, digital badging, virtual reality** and more.

ISS @20

- Bring **ISS into the classroom!** Leverage STEM on Station content, provide student opportunities to engage in ISS research and deliver the excitement of science and technology to students in the classroom.
- *This is a milestone. It symbolizes exploration by all that dare to dream and work hard to achieve that dream we hope an inspiration for all **future explorers***. Astronaut Christina Koch, October 18, 2019.

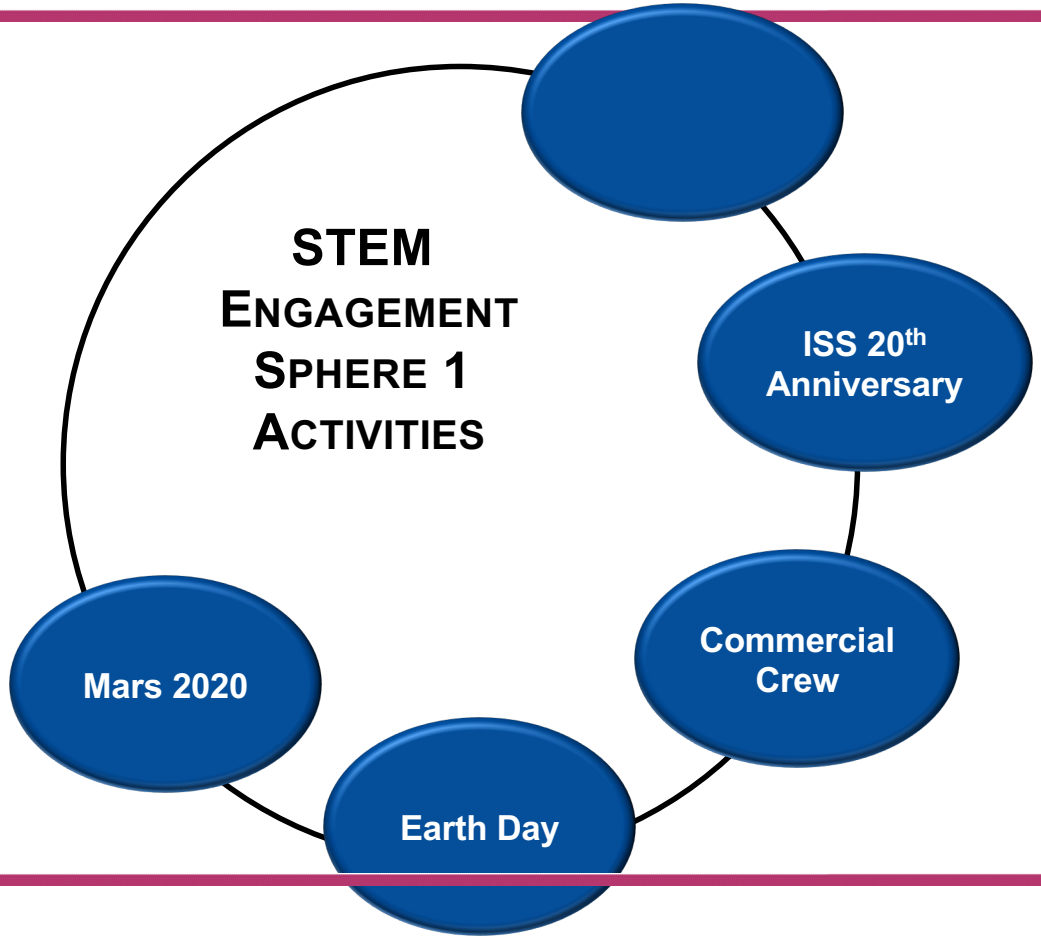
Mars 2020

- Create and disseminate **immersive virtual experiences**, classroom lessons and activities for students and educators in advance of the launch and landing of Mars 2020.
- Utilize Mars 2020 as a platform to **engage a broad and diverse** student population across the U.S.

Earth Day

- Engage students and educators through content, lessons and activities that use the vantage point of space to **understand and explore our home planet** and create powerful connections to the 50th Anniversary of Earth Day.

SPHERE 1 IMPACT AND SUCCESS CRITERIA



Success criteria:

- Increased diversity of student and institution participation
- Movement along the continuum of the design principles
- Documented improvements and/or resulting outcomes
- Defined metrics for each activity
- STEM Engagement content is consistent and streamlined

Envisioned impacts:

- Increased leverage and coordination of Agency resources
- Increased and broader participation
- Enhanced diversity of students and institutions
- Expanded geographic reach
- Expanded network across Agency and external partners
- Increased scope and scale
- Increased access to cadre of experts

SPACE GRANT: LONG TERM FOCUS AREAS

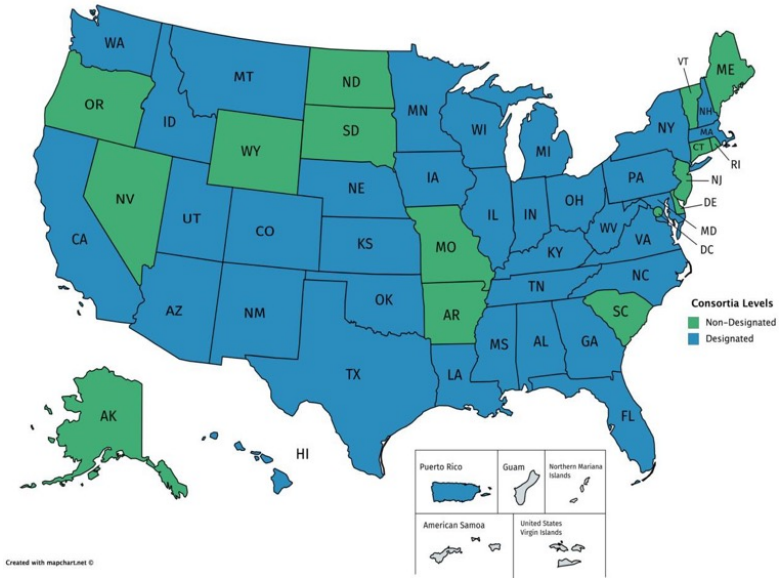
Broadly engage **all Mission Directorates** to define and implement **cost-sharing opportunities** spanning our agency-wide portfolio, with a large array of identified benefits:

- Technical needs of NASA's Mission Directorates directly addressed
- Student experiences genuinely contribute to NASA's mission, leading to high-quality, exciting, authentic experiences as a result
- A vast nationwide network of strategic partners, such as the Space Grant Consortia, becomes more energized … and expands over time

Identify and promote best practices, follow-on efforts are scaled up, and nationwide, **diverse student participation grows** while bringing NASA's missions closer to communities across the nation … ***which will be an interactive and iterative process***

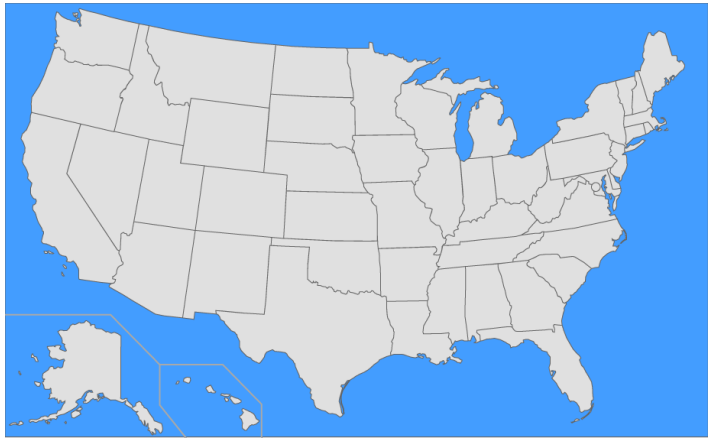
Past Funding Structure

Status	Number of Awards		
Designated	35	$760,000	
Non-Designated	17	$570,000	

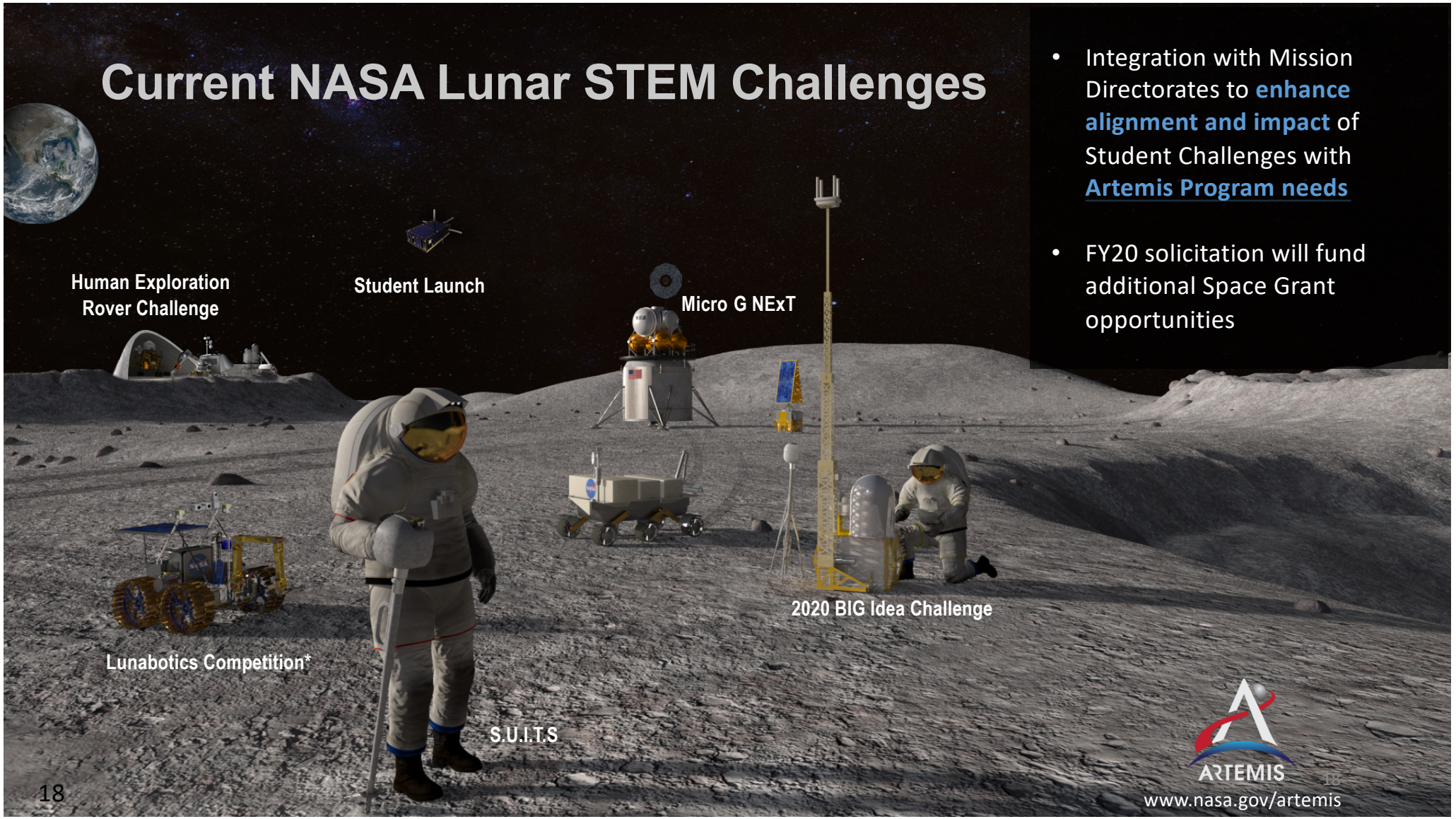


New Funding Structure

Status	Number of Awards		
Equal Awards	52	$700,000	
Guam and Virgin Isl	2	$150,000	Via Hawaii and So. Carolina



Current NASA Lunar STEM Challenges



- Integration with Mission Directorates to **enhance alignment and impact** of Student Challenges with **Artemis Program needs**
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ARTEMIS
www.nasa.gov/artemis

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STATUS: EVOLUTIONARY ACTIVITIES

Artemis Student Challenges (HEOMD and STMD)

- 2019 Artemis-focused Request For Information (RFI)
- August 2019 ..... RFI Closed
- September 2019 ..... Review RFI Responses and strategize next steps with HEOMD/STMD
- November 2019 ..... Release Solicitation to the Space Grant Community
- Est. Early-2020 ..... Selection of One-Year Pilot Activities and/or Planning Awards

Space Technology Mission Directorate (STMD)

- 2020 BIG Idea Challenge
- August 2019 ..... Details Publically Released: Focus is on Lunar Exploration in the Permanently Shaded Regions and In Situ Resource Utilization
- January 2020 ..... Proposals Due
- February 2020 ..... Selections Made

Administrator Bridenstine Visited Georgia Tech on July 31st and shared his vision:

"When we partner with a university … the students actually develop the technology that we fly to the moon. And then, when they graduate, not only do they have the educational background, but they have the hands-on experience that we can take advantage of and put them right to work."

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The 2020 BIG Idea Challenge

Seeks innovative ideas from the academic community for a wide variety of concepts, systems, and technology demonstrations to address near-term technology capability requirements to support NASA's exploration objectives for Permanently Shadowed Regions in and near the Moon's polar regions

http://bigidea.nianet.org/

- Objective: Develop a STEM-trained workforce with skills and experience aligned directly with agency mission needs through rigorous competition designed to address technical gaps required to advance space exploration.
- Eligibility: US Space Grant universities; non-space grant universities may partner with a lead Space Grant university; undergrad and graduate
- 5-8 teams; 5-20 students per team
- $50K - $180K development and participation stipend per university team (matching funds between STMD and Space Grant)
- Competitive Elements: Proposal; Mid-Point Project Review/Video; Proof-of-Concept; Technical Paper; Poster; Judged F2F Design Review; Model/Prototype/Demonstration
- Challenge Launched August 2019; Full academic-year cycle PLUS extension through October

FY20 BIG Idea Proposal Themes/Categories

Exploration of PSRs in polar regions

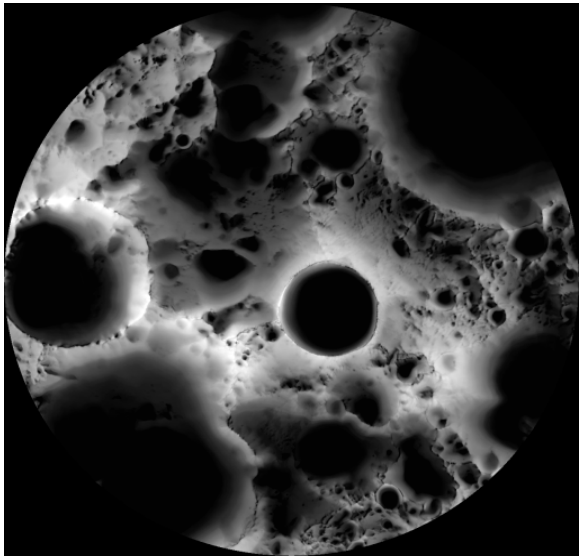
- Characterizing the regolith/ surface consistency within the PSR
- Locating and characterizing lunar water, or other hydrogen-rich deposits
- Identifying water concentrations - understanding how water ice is mixed with the regolith
- Thermal environment of the regolith in a PSR

Technologies to support Lunar ISRU in a PSR

- Collecting icy regolith
- Transporting and storing collected water
- Water purification
- Demonstrating electrolysis in the relevant environment

Capabilities to explore and operate in PSRs

- Innovations in mobility systems
- Innovations in navigation systems
- Innovations in power systems
- Innovations in communications systems
- Innovations in sensing systems



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