INSPIRE - ENGAGE - EDUCATE - EMPLOY
The Next Generation of Explorers

NASA ADVISORY COUNCIL STEM ENGAGEMENT COMMITTEE
OFFICE OF STEM ENGAGEMENT UPDATE
OCTOBER 29, 2019

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ASSOCIATE ADMINISTRATOR FOR STEM ENGAGEMENT

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NASA’S CONTRIBUTIONS TO AMERICA’S STEM ECOSYSTEM

US STEM Challenges
- US PISA (2015) scores 26th internationally
- Projected STEM R&D job growth 8.9% (2024)
- Women in S&E occupations <33%
- Underrepresented minorities in S&E <11% below their share of the population (27%)

NASA STEM Engagement

NASA & Aerospace Workforce Needs
- NASA workforce average age: 48.9
- Diverse pipeline

Students & Educational Institutions
- Authentic STEM learning experiences
- Research opportunities

NASA Mission Needs
- Research
- Technology development
- Operations

NASA’s Alignment with OSTP/OMB Priorities

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

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

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

*OSTP/OMB
ARCHITECTURE ENABLING STUDENT OPPORTUNITIES & CONTRIBUTIONS

FOCUS AREAS

Evidence-based strategies
Create unique opportunities for students to contribute to NASA's work.

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

Integrated operational model
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
NASA STRATEGY FOR STEM ENGAGEMENT

FOCUS AREAS

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

Build a diverse, skilled, future STEM workforce

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

OBJECTIVES

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.

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.

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

STEM Engagement Goals and Requirements

STEM Engagement Activities

Mission Activities

STEM Practitioners

NASA · Industry · Academia

Students

NASA STEM Engagement Portfolio

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The Next Generation of Explorers
Mission Goals, Needs and Requirements

- Evidence-based drivers
  - Performance data
  - Literature/research data

STEM Engagement Goals and Requirements

- Internships
- Challenges, Competitions or Contests
- Fellowships
- Research and Development Opportunities
- Pre-College STEM Experiences
- College STEM Experiences
- Faculty & Educator Support
- Institutional Support
- Virtual Learning Opportunities
- STEM Content / Products

Portfolio Categories

Portfolio Criteria

1. Scope
2. Design Principles
3. Strategic Alignment
4. Benefit

SEC Review & Prioritization

Sphere 1
Sphere 2

Student contributions to NASA’s work in action

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<table>
<thead>
<tr>
<th>Activity Type</th>
<th>TOTAL</th>
<th>Beneficiaries</th>
<th>1. Enabling Contributions</th>
<th>2. Building a Diverse Workforce</th>
<th>3. Strengthen Understanding</th>
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Total Activities: 94
## NASA STEM Engagement Portfolio Snapshot
### Contributions by Organization

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<tr>
<th>Types of Activities</th>
<th>ARMD</th>
<th>HEOMD</th>
<th>SMD</th>
<th>STMD</th>
<th>OSTEM</th>
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<td>Pre-College STEM Experiences</td>
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<td>College STEM Experiences</td>
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<td>STEM Content &amp; Products</td>
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<tr>
<td>Institutional Support</td>
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<td>Faculty &amp; Educator Support</td>
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<td></td>
<td>9</td>
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<td><strong>16</strong></td>
<td><strong>17</strong></td>
<td><strong>9</strong></td>
<td><strong>43</strong></td>
<td><strong>1</strong></td>
<td><strong>94</strong></td>
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</table>

*Note: Supported by Center-Based or other Functional Offices*
## STEM Engagement Portfolio Design Principles and Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>STEM Engagement Implications</th>
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<tbody>
<tr>
<td>1. Scope</td>
<td>STEM Engagement includes all of NASA’s efforts to attract, engage and educate students and support educators and institutions.</td>
</tr>
<tr>
<td>2. Design Principles</td>
<td>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.</td>
</tr>
<tr>
<td>3. Alignment</td>
<td>Demonstrates direct alignment and contributions to the NASA Strategy for STEM Engagement objectives and strategies and the NASA Strategic Plan.</td>
</tr>
<tr>
<td>4. Benefits</td>
<td>Has a direct or indirect benefit to students.</td>
</tr>
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### Design Principles

<table>
<thead>
<tr>
<th>Design Principles</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mission-driven authentic STEM experiences</td>
<td>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.</td>
</tr>
<tr>
<td>Evidence-based practices</td>
<td>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.</td>
</tr>
<tr>
<td>Diversity and inclusion</td>
<td>Infuse objectives and target strategies, where practicable, to attract and sustain diversity in student participation, and to incorporate approaches to foster and promote inclusion.</td>
</tr>
<tr>
<td>Scalability through partnerships and networks</td>
<td>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.</td>
</tr>
</tbody>
</table>

*SEC Member Concurrence April 2019*
FY2020 STEM Engagement Sphere 1 Activities

STEM Engagement Sphere 1 Activities

- Mars 2020
- Commercial Crew
- Earth Day
- ISS 20th Anniversary

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
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

<table>
<thead>
<tr>
<th>Status</th>
<th>Number of Awards</th>
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<tbody>
<tr>
<td>Designated</td>
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<tr>
<td>Non-Designated</td>
<td>17</td>
<td>$570,000</td>
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## New Funding Structure

<table>
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<tr>
<th>Status</th>
<th>Number of Awards</th>
<th>Value</th>
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<tbody>
<tr>
<td>Equal Awards</td>
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<td>$700,000</td>
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<tr>
<td>Guam and Virgin Isl</td>
<td>2</td>
<td>$150,000</td>
<td>Via Hawaii and So. Carolina</td>
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</table>
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

Human Exploration Rover Challenge
Student Launch
Micro G NExT
2020 BIG Idea Challenge
Lunabotics Competition
S.U.I.T.S

www.nasa.gov/artemis
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.”
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.

- 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

http://bigidea.nianet.org/
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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