NASA Advisory Council
STEM Engagement Committee

Mike Kincaid
Associate Administrator STEM Engagement

NASA STEM Engagement

1. Key Updates
   - Moon 2024 & National Space Council
   - Strategy & Portfolio
   - MAP Progress

2. Connecting Nation's STEM to NASA's Mission
   - Team II
   - Partnerships
   - NextGen STEM CCP Activities
   - Sparking an Interest in STEM

3. Discussion & Finalize Findings/Recommendations

Fifth National Space Council Meeting

March 26, 2019

VP Pence announced plans to return **U.S. astronauts** to the surface of the **Moon by 2024**, with report from NASA Administrator Bridenstine

Expert Panel 1: Ready to Fly

- Les Lyles, retired U.S. Air Force general and former Vice Chief of Staff of the Air Force
- Eileen Collins, retired U.S. Air Force officer and former NASA astronaut
- Sandy Magnus, former NASA astronaut

Expert Panel 2: Ready to Explore

- Dan Dumbacher, American Institute of Aeronautics and Astronautics
- Jack Burns, University of Colorado at Boulder
- Wanda Sigur, independent consultant

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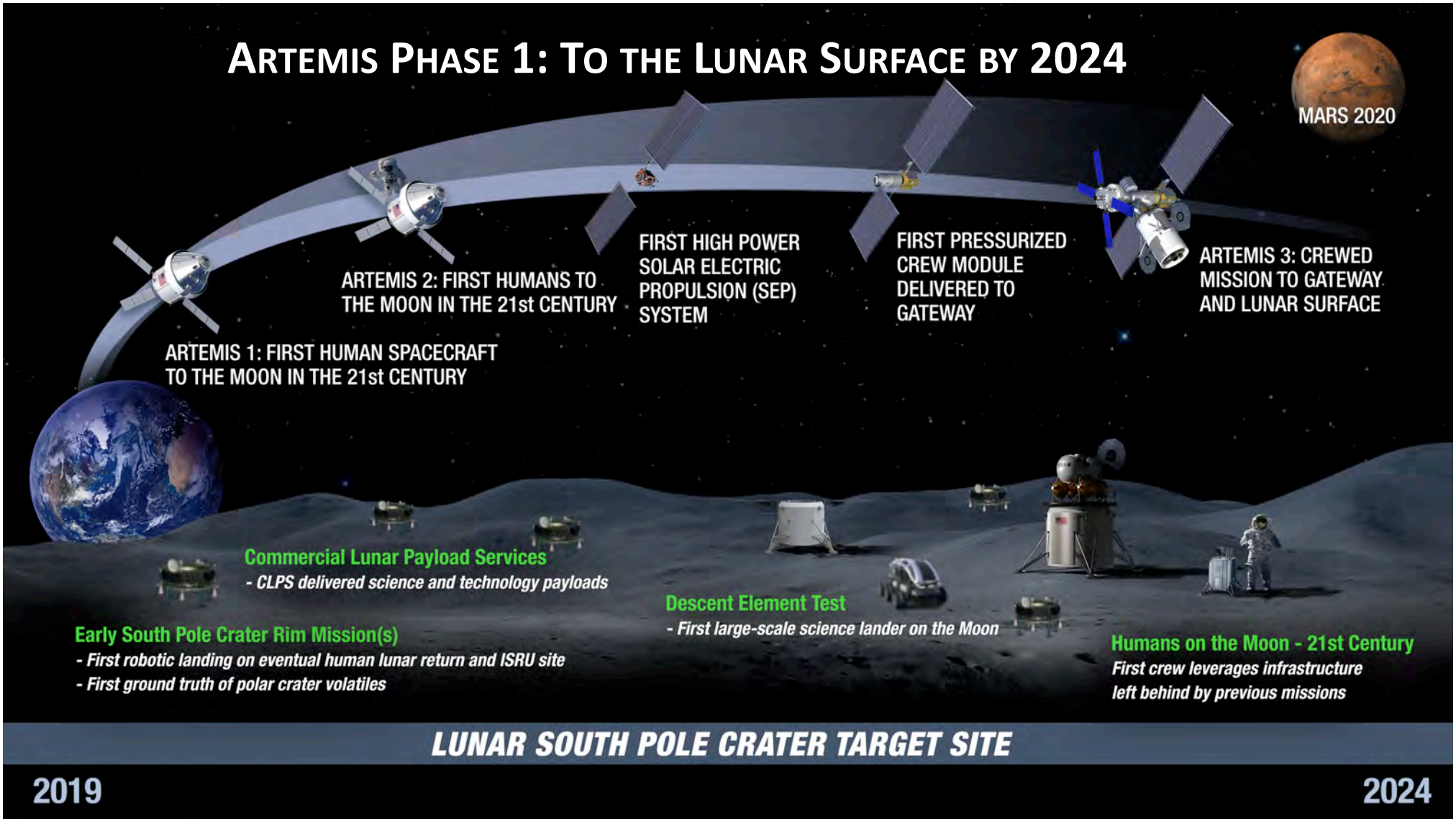
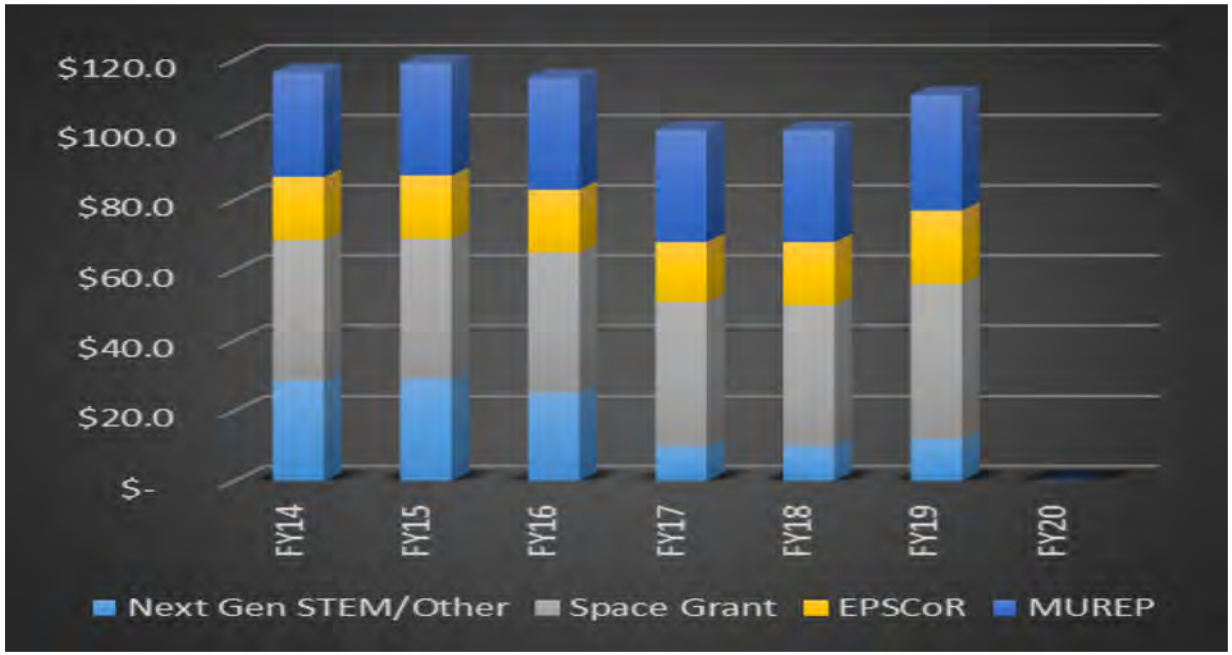
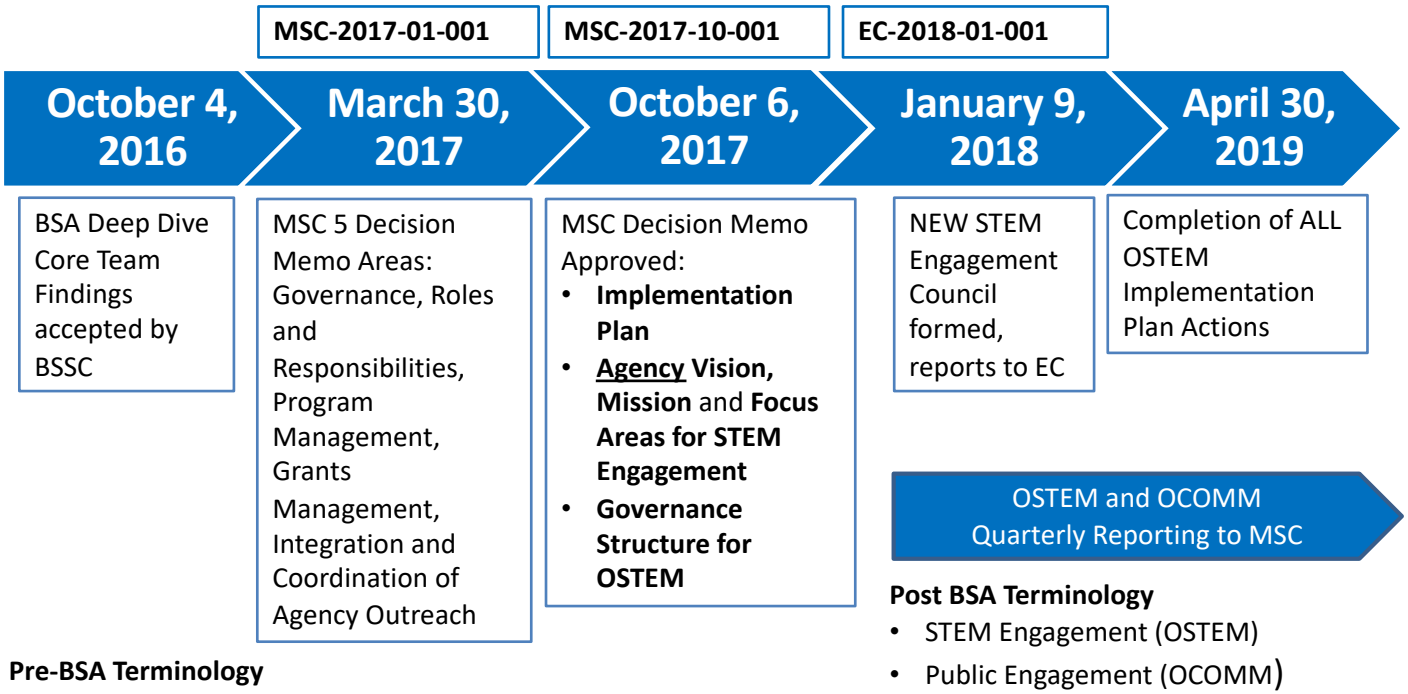

ARTEMIS PHASE 1: TO THE LUNAR SURFACE BY 2024
MARS 2020
ARTEMIS 1: FIRST HUMAN SPACECRAFT TO THE MOON IN THE 21st CENTURY
ARTEMIS 2: FIRST HUMANS TO THE MOON IN THE 21st CENTURY
FIRST HIGH POWER SOLAR ELECTRIC PROPULSION (SEP) SYSTEM
FIRST PRESSURIZED CREW MODULE DELIVERED TO GATEWAY
ARTEMIS 3: CREWED MISSION TO GATEWAY AND LUNAR SURFACE
Commercial Lunar Payload Services
- CLPS delivered science and technology payloads
Early South Pole Crater Rim Mission(s)
- First robotic landing on eventual human lunar return and ISRU site
- First ground truth of polar crater volatiles
Descent Element Test
- First large-scale science lander on the Moon
Humans on the Moon - 21st Century
First crew leverages infrastructure left behind by previous missions
LUNAR SOUTH POLE CRATER TARGET SITE
2019
2024

BUDGET HISTORY



$M	FY14	FY15	FY16	FY17	FY18	FY19	FY20
Next Gen STEM/Other	$ 28.6	$ 29.0	$ 25.0	$ 10.0	$ 10.0	$ 12.0	$ -
Space Grant	$ 40.0	$ 40.0	$ 40.0	$ 40.9	$ 40.0	$ 44.0	$ -
EPSCoR	$ 18.0	$ 18.0	$ 18.0	$ 17.1	$ 18.0	$ 21.0	$ -
MUREP	$ 30.0	$ 32.0	$ 32.0	$ 32.0	$ 32.0	$ 33.0	$ -
Total STEM Engagement Funding	**$ 116.6**	**$ 119.0**	**$ 115.0**	**$ 100.0**	**$ 100.0**	**$ 110.0**	**$ -**

STEM ENGAGEMENT BSA IMPLEMENTATION TIMELINE



Pre-BSA Terminology

- Education (Office of Education)
- Outreach (Office of Communications)

Post BSA Terminology

- STEM Engagement (OSTEM)
- Public Engagement (OCOMM)

Accomplished implementation plan approach over an 18 month period – finishing 6 months early, despite budget challenges and 35-day partial government shutdown.

STEM Engagement Transformation Highlights

Systemic	Programmatic

✓ STEM Engagement Council
✓ New STEM Engagement function and Office of STEM Engagement
✓ New agency Strategy for STEM Engagement
✓ New performance measurement and evaluation approach
✓ Integrated agency STEM Engagement Portfolio
✓ Annual agency STEM Engagement planning process
✓ New STEM Engagement NASA Policy Directive (in formal NODIS process)
✓ Capabilities-driven model with assignment of functional roles and responsibilities
  ✓ Performance Measurement & Evaluation
  ✓ Educational Platforms and Capabilities
  ✓ Internships
✓ Enhanced infrastructure, tools & systems
  ✓ New NASA Internship Portal
  ✓ New NASA STEM Engagement Search Engine for students and educators
  ✓ New enterprise performance measurement system under construction
	✓ An integrated program management approach for appropriated program
	✓ Significant changes to appropriated programs:
	  ✓ New Next Gen STEM project, replacing SEAP, incorporating significant changes to approach
	  ✓ Streamlined MUREP with more focused, strategic award initiatives
	  ✓ New multi-year solicitation for Space Grant with key changes
	✓ Rigorous, systematic program and fiscal management practices
	✓ Project management and grants management training requirements – in implementation

New Architecture Enabling Student Opportunities & Contributions

NASA Mission Directorate Drivers & Requirements






Focus Areas

Evidence-based strategies

Rigorous planning

Integrated operational model

Create unique opportunities for students to contribute to NASAs work.

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

Strengthen public understanding by enabling powerful connections to NASAs 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

Middle School

High School

Undergraduate

Graduate

NASA Strategy for STEM Engagement

The *NASA Strategy for Science, Technology, Engineering and Math (STEM) Engagement* serves as a roadmap to frame and guide the agency's work in STEM engagement over the next 3 years.

Beneficiaries of NASA's STEM Engagement Portfolio


Elementary


Middle School


High School


Undergraduate


Graduate

STEM engagement is comprised of a broad and diverse set of programs, projects, activities and products developed and implemented by HQ functional Offices, Mission Directorates and Centers.

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NASA Strategy for STEM Engagement

Focus Areas

Enable contributions to NASA's work

Build a diverse, skilled, future workforce

Strengthen STEM through connections to NASA

Objectives

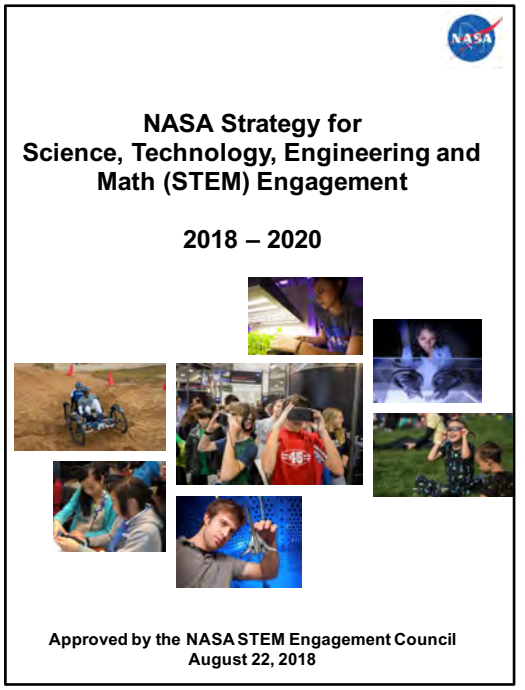
- Mission-driven student contributions

  pipeline
- Connecting with students

Strategies

- Strategies toward

  objectives aligned with Vision focus areas



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NASA Strategy for STEM Engagement

Focus Areas

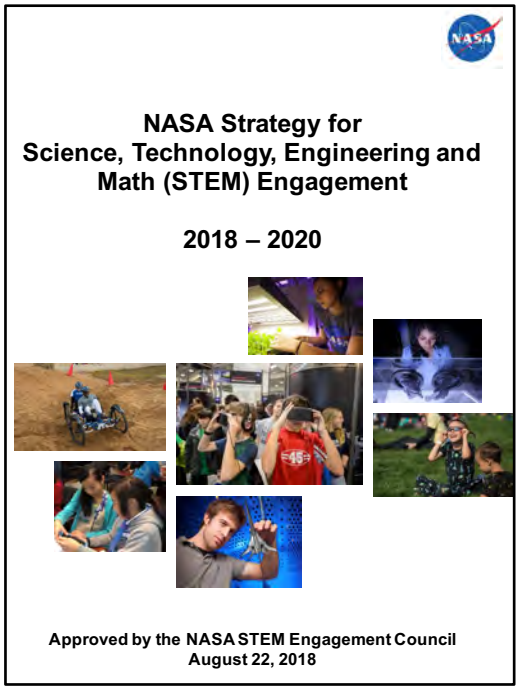
Enable contributions to NASA's work

Build a diverse, skilled, future workforce

Strengthen STEM through connections to NASA

Objectives

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



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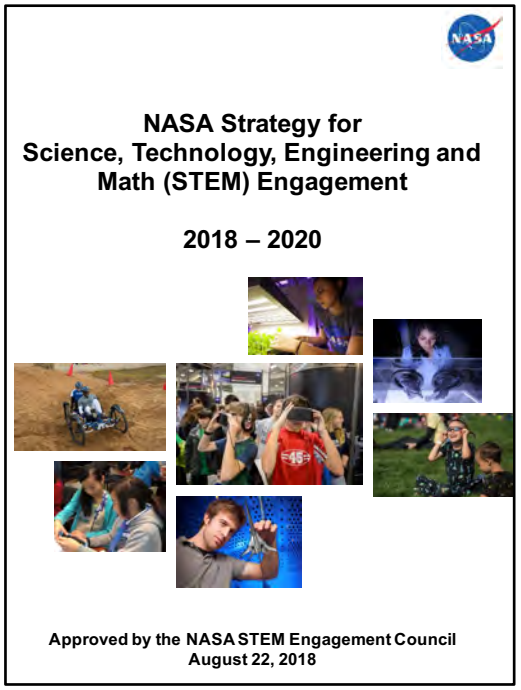
NASA Strategy for STEM Engagement

Focus Areas

- **Enable contributions to NASA's work**
- **Build a diverse, skilled, future workforce**
- **Strengthen STEM through connections to NASA**

Objectives

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



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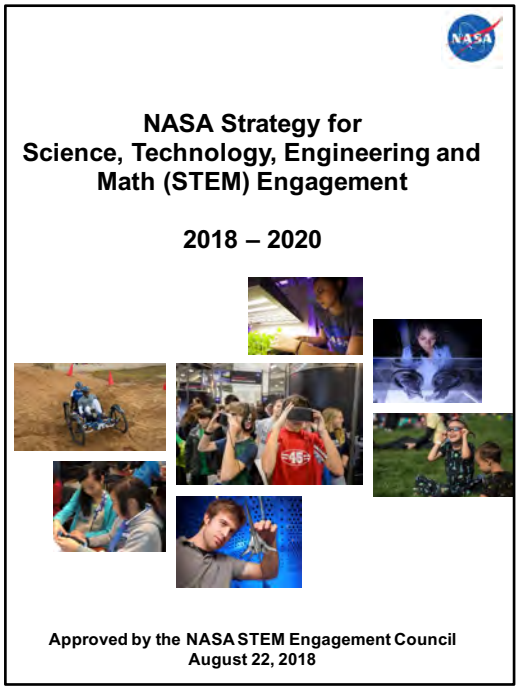
NASA Strategy for STEM Engagement

Focus Areas

- Enable contributions to NASA's work
- Build a diverse, skilled, future workforce
- Strengthen STEM through connections to NASA

Objectives

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



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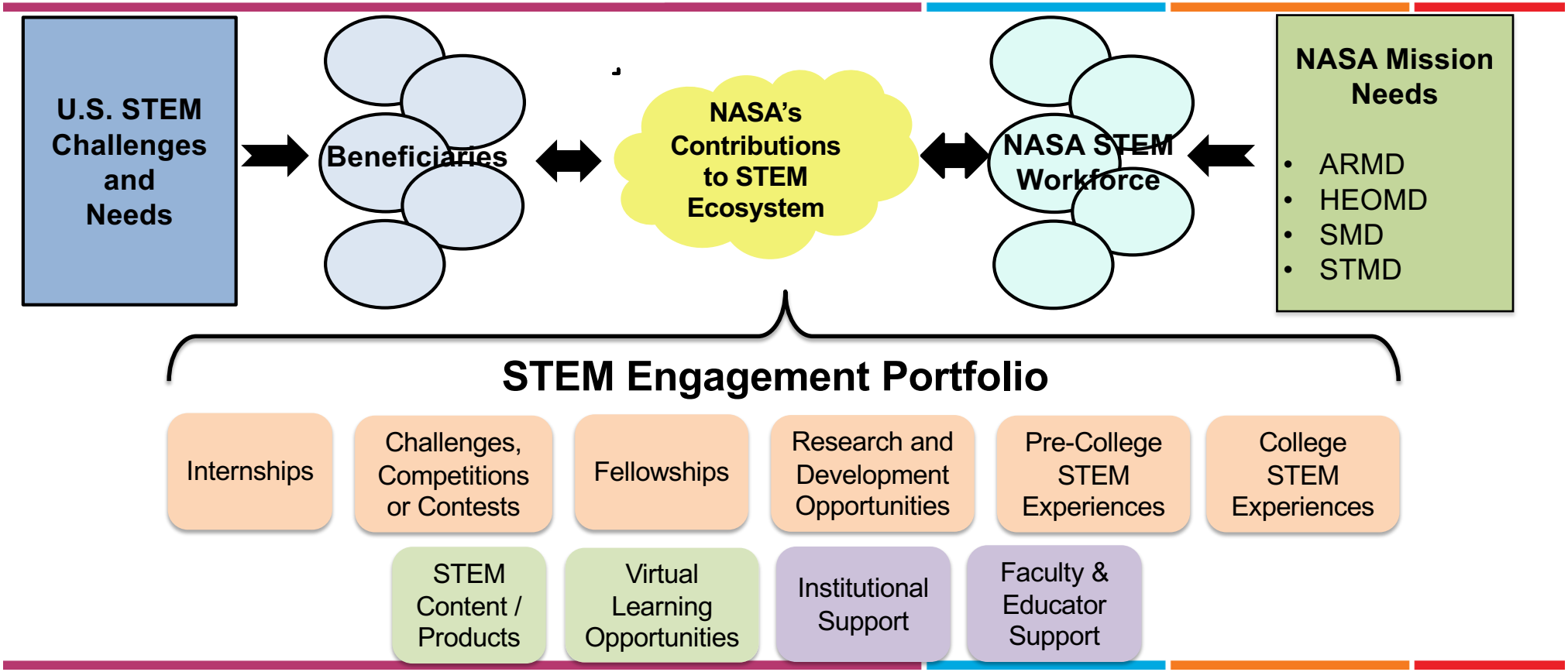
NASA STEM Engagement Portfolio



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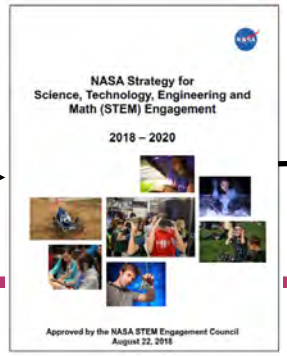
STEM Engagement Portfolio Drivers & Contributions

Student contributions to NASA's work in action

Mission Goals, Needs and Requirements

Mission-driven



STEM Engagement Goals and Requirements

Mission Activities

STEM Engagement Activities

Government / Other Agencies

Industry

Academia

Students

NASA STEM Engagement Portfolio

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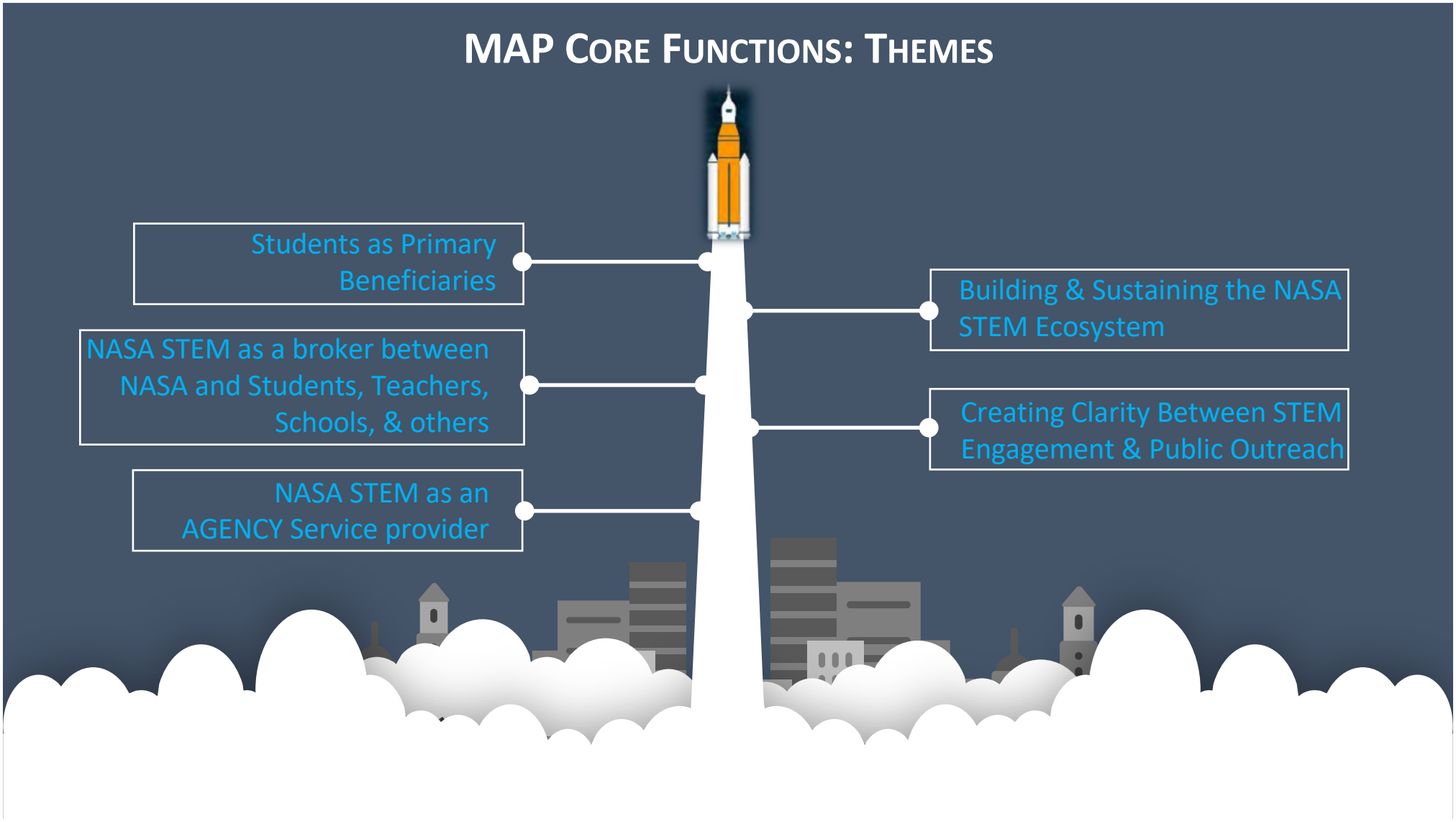
MAP Core Functions: Themes



CORE FUNCTION 1:
A COMPREHENSIVE STEM ENGAGEMENT PROGRAM FOR NASA

STEM Engagement Strategy, Planning, Integration and Oversight

Congressionally Appropriated Projects

- Space Grant
- MUREP
- EPSCoR
- NextGen STEM

Student Experiential Work & Learning Opportunities

- Internships and fellowships
- Challenges, contests, competitions

Engagement Support for Educators/Faculty

- Direct financial support
- Access to NASA personnel and facilities

STEM Education Conferences; STEM experiential activities in schools

KEY EXAMPLES

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CORE FUNCTION 2:
SERVICE PROVIDER FOR THE AGENCY

Providing an agency wide infrastructure for administering student internships

Providing expertise to build and facilitate effective relationships with Minority Serving Institutions

Providing measurement, assessment and evaluation of NASA s STEM Engagement investments

Partnering in development and delivery of NASA STEM products and platforms to assure quality and integrity

KEY EXAMPLES

NASA STEM Engagement

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TEAM II SOLICITATION

Teams Engaging Affiliated Museums and Informal Institutions

2019 Solicitation Underway

Due Date: August 13, 2019

Theme:

Moon to Mars

- Experiential-based educational opportunities in informal settings targeted at grades 4-8
- Utilize networks with wide range of organizations to enable broad dissemination
- Proposals directly tied to and amplify the Moon to Mars theme

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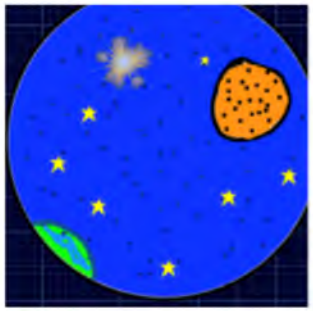
PARTNERSHIP: TYNKER

MOON 2 MARS CHALLENGES

Series of coding challenges based on NASA space missions

- **Challenge 1:**
  - **Deadline May 5th**
  - **>7,000 unique entries**
  - **Winners were announced May 20)**
- **Challenge 2: September 2019**
- **Challenge 3: November 2019**

Forward to the Moon Design a Mission Patch Design Challenge Winners Announced



TYNKER
The Creative Computing Platform

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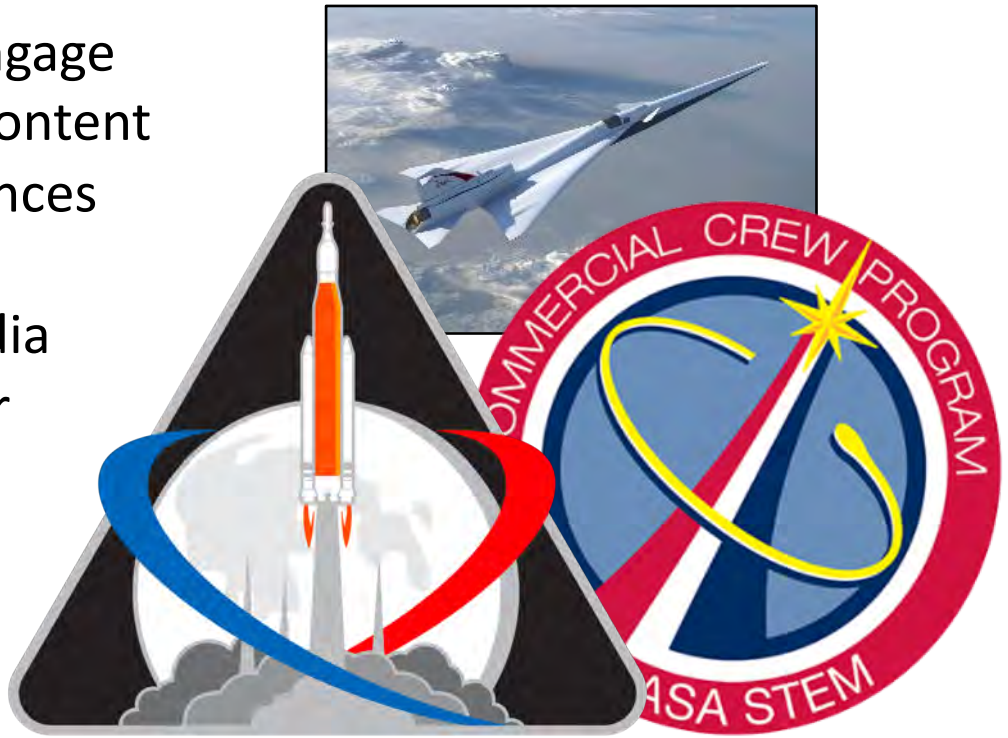
NEXT GEN STEM: PILOT THEMES

- ✓Evidence-based pilot activities to engage middle school students in mission content
  - ✓Hand's on Inquiry Based Experiences
  - ✓Educator Support Materials
  - ✓Digital Resources and Social Media
  - ✓Partner Driven Collaborations for Implementation
  - ✓Leverage existing Agency STEM Engagement resources



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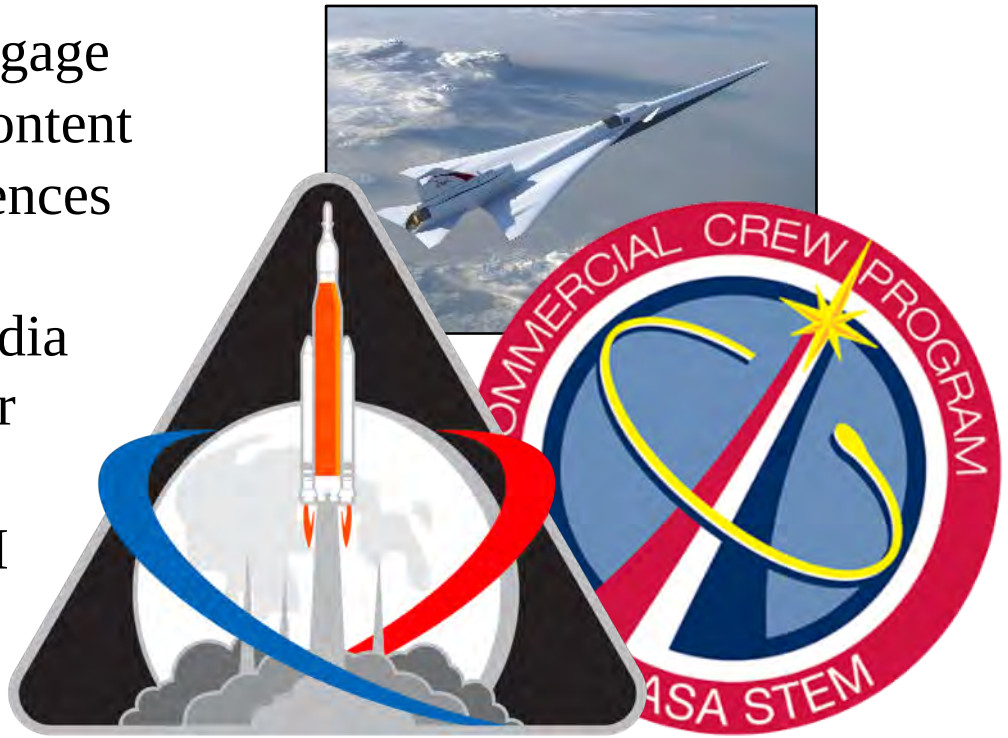
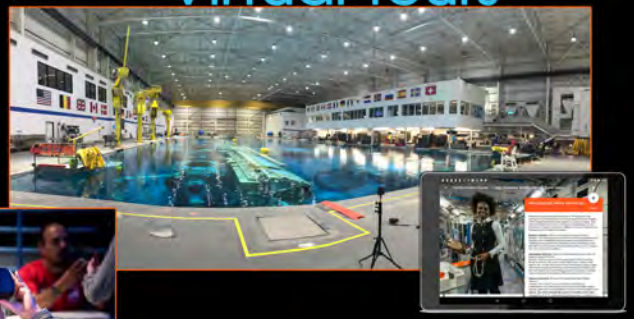


NASA EXPLORES

WITH STEM & COMMERCIAL CREW

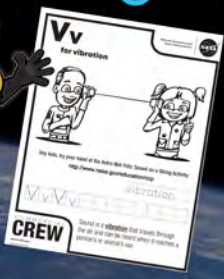
Virtual Tours



Digital Learning

Classroom Activities

Engineering Design Challenges



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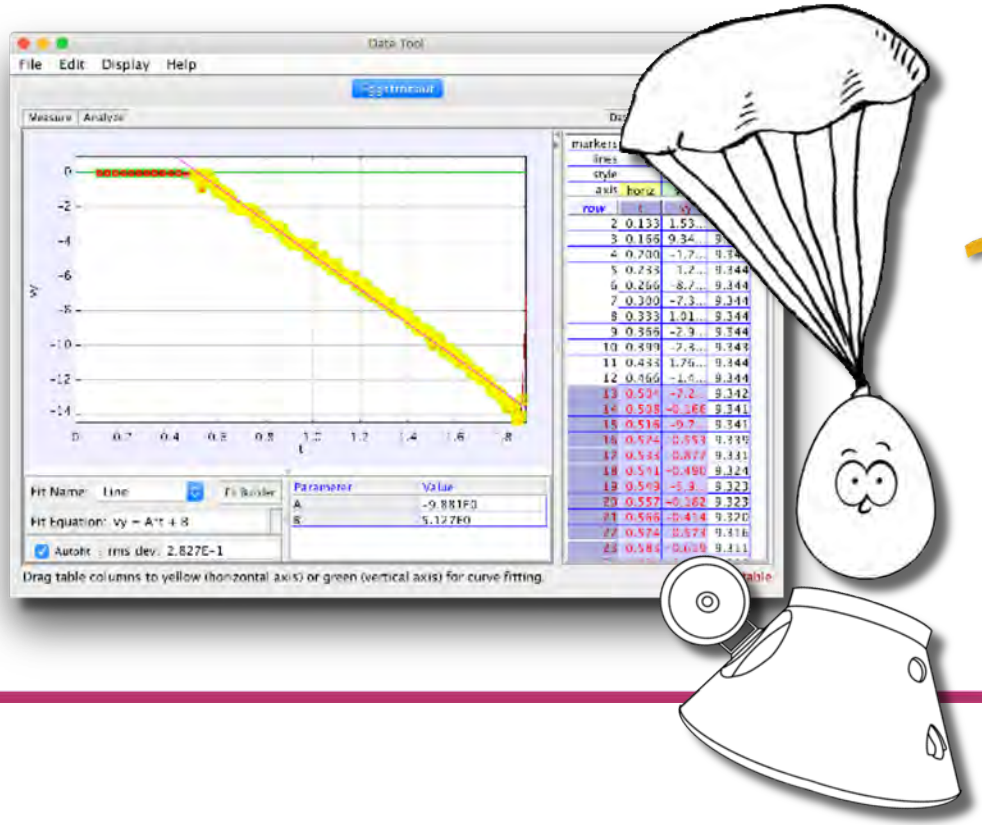
GRADES 5-12 ACTIVITIES

- Engineering design challenges



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VIRTUAL REALITY FIELD TRIPS

NEXT GEN STEM: PILOT THEMES

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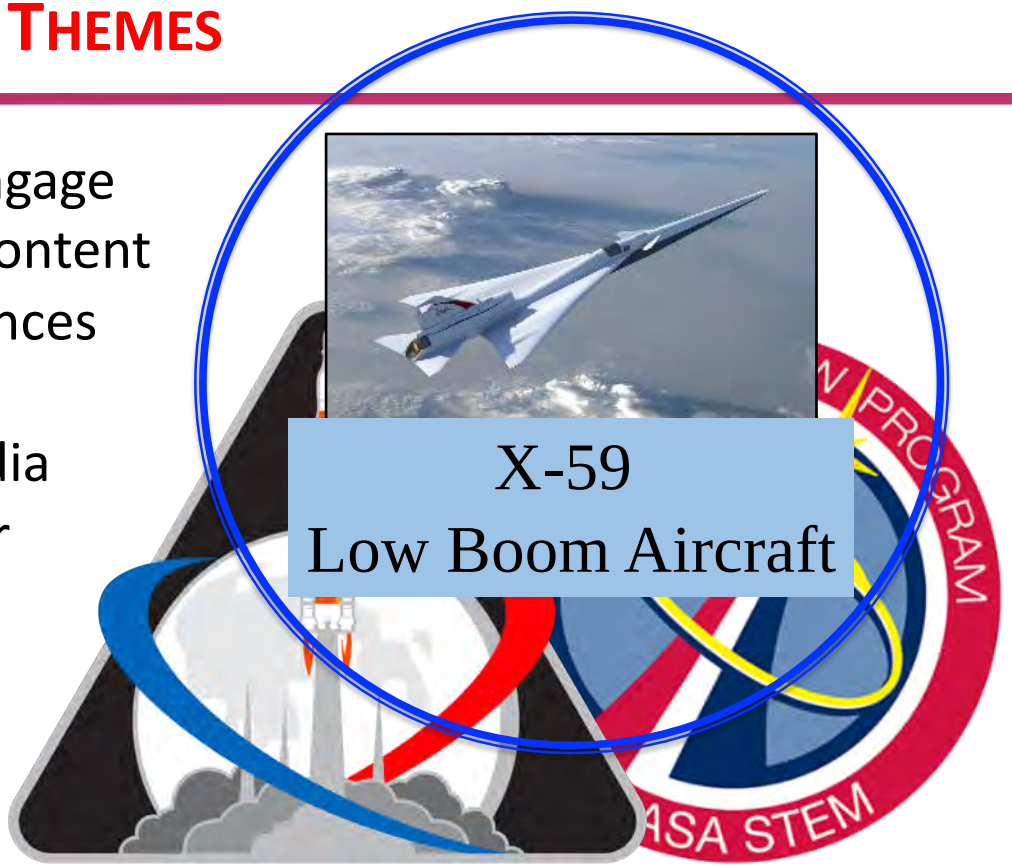
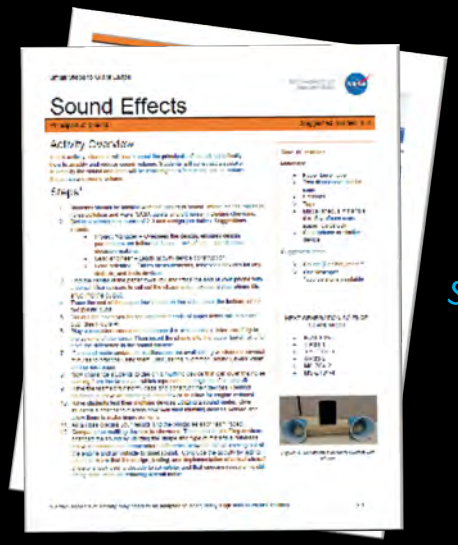


Individual Activity Guides

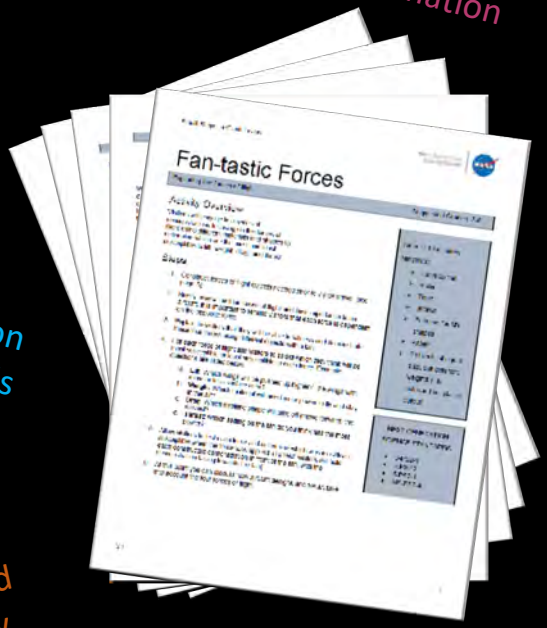
Activity Overviews

Step by Step Instructions



Education Standards

NASA Mission Background Information



Suggested Grade Levels

Required Activity Materials

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Activity Demonstration Videos

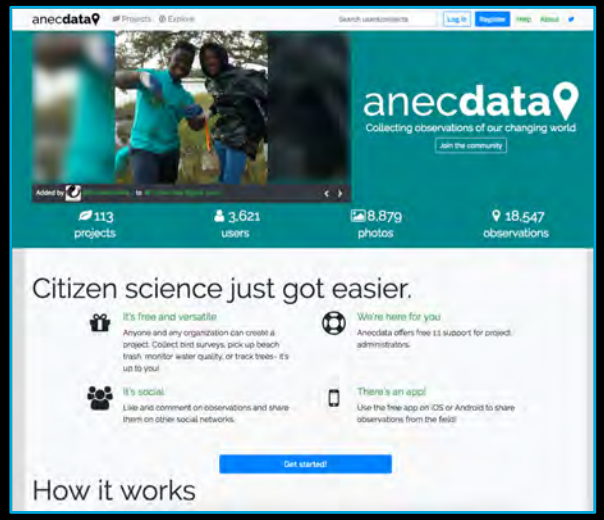
Senses of Sound

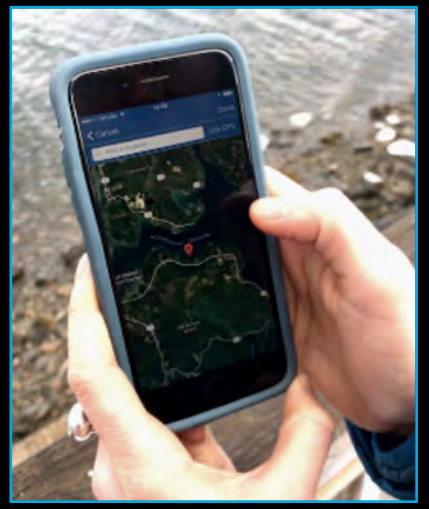
Sound Effects

Viewing Locations: SSGL Website, NASA Images, NASA Education YouTube, NASA Edge Website

NASA'S LOWER THE BOOM – CITIZEN SCIENCE ACTIVITY

Anecdata
Citizen Science Data Collection App

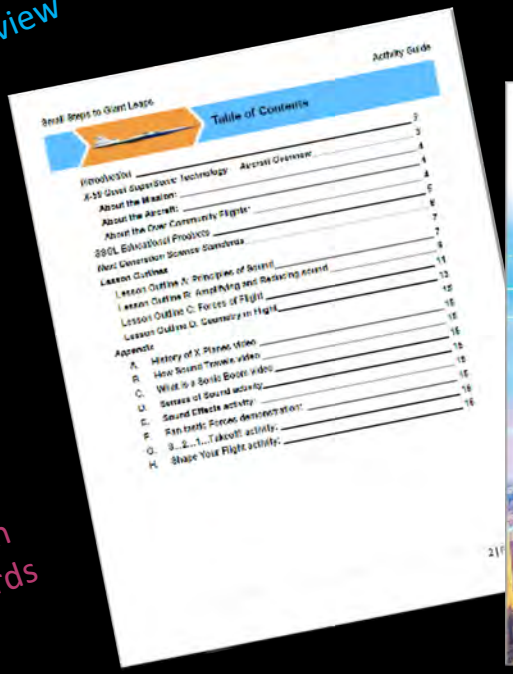


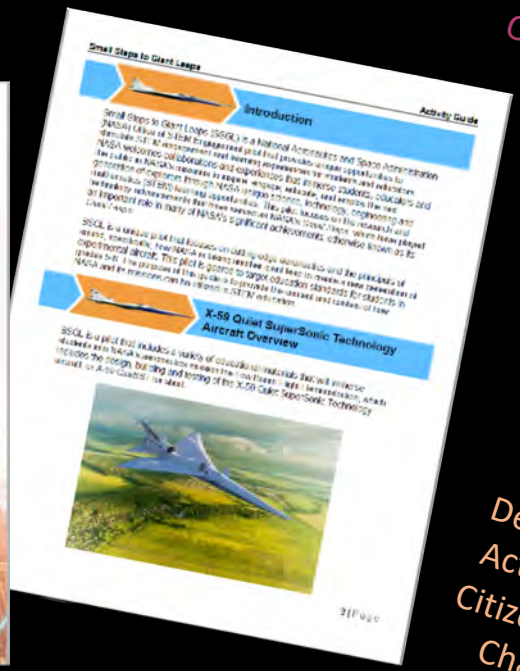


COMPREHENSIVE ACTIVITY GUIDE

Mission and Aircraft Overview

Example Lesson Outlines





Next Generation Science Standards Table

Description of Activities and Citizen Science Challenge

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NEXT GEN STEM: PILOT THEMES

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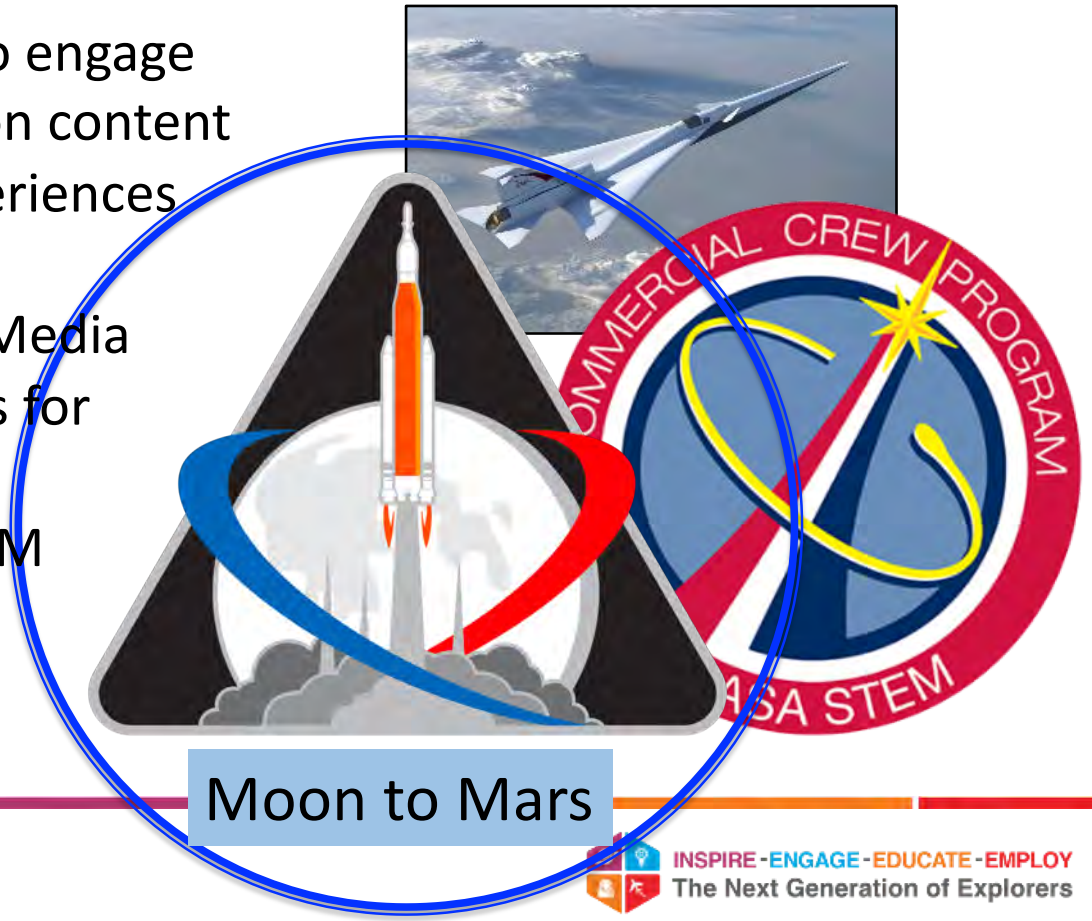

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Moon to Mars:

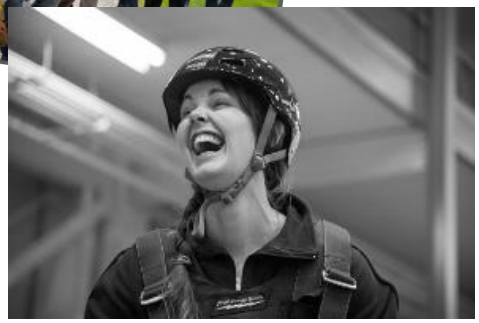
Powering into Deep Space

Educator Training and Webinars

NASA-relevant Coding Challenges

Curriculum Support Materials – SLS, Orion, Gateway

Engineering Design Challenges



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All 3 Themes

Educator Webinars
Student and Educator Digital Badging

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OSTEM Diversity Data Key Points

Both in government and industry attracting and retaining diverse students in a STEM challenge

Government and industry are competing for students within a limited pool of applicants

Nationally there are some positive upticks in enrollments at Universities

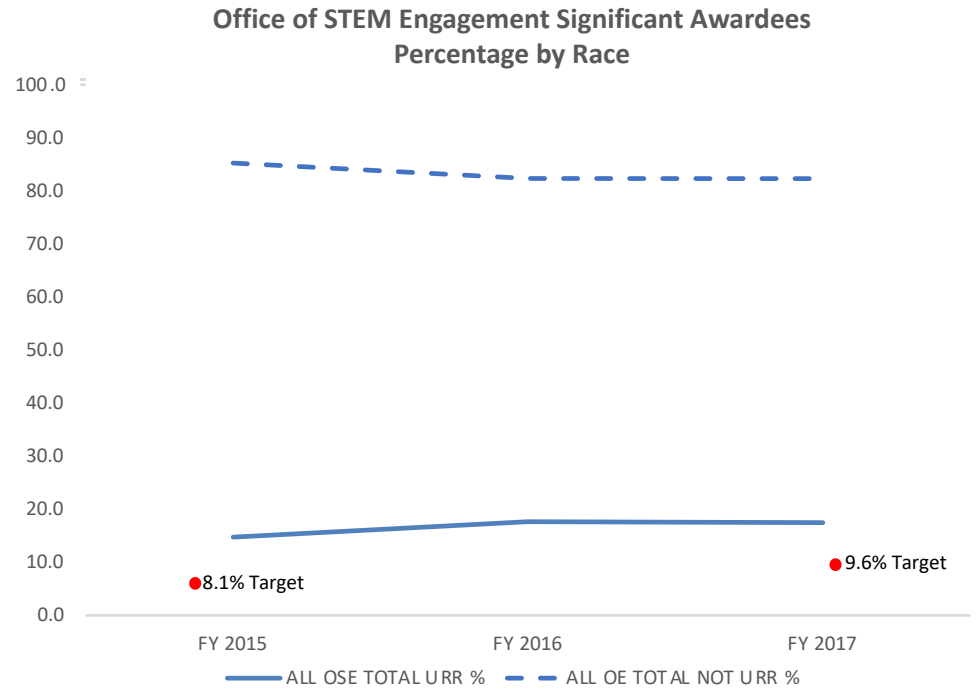
Across 3 years trends, OSTEM is exceeding performance measures with students who self identify with underrepresented race and ethnicity categories

OSTEM is looking across funded grants and opportunities to identify positive outliers to study further for identification of best practices

OSTEM Student Awards: Race

	# of Significant Awardees	Not URR** #	Not URR** (%)	URR*** #	URR*** (%)	DNR Race #
FY 2015						
All OSE	3,673	2,676	(85.3)	463	(14.8)*	534
FY 2016						
All OSE	7,519	5,489	(82.3)	1,177	(17.7)*	853
FY 2017						
All OSE	7,409	5,469	(82.4)	1,168	(17.6)*	772

Note: * indicates years that awardees exceeded the national average for racially underrepresented students enrolled in 4-year STEM degree programs.
** Not Underrepresented Race (URR) = Asian and White
***Underrepresented Race (URR) = Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander.
DNR = Did not report

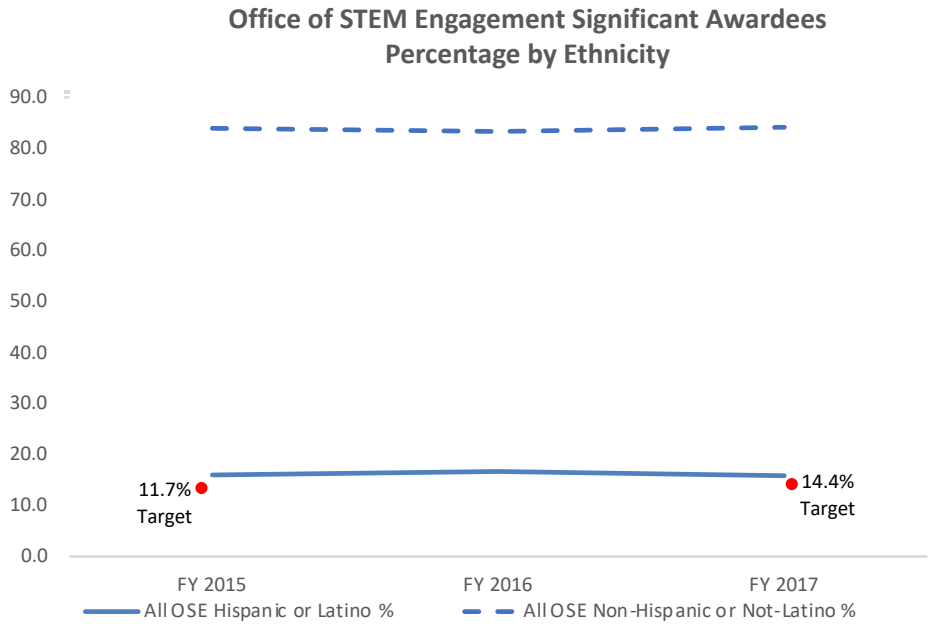


Note: Red dot ( ) indicates the national average for underrepresented students enrolled in STEM degree programs. The U.S. Department of Education's Integrated Postsecondary Education Data System (IPEDS) reported 8.1 percent of enrollees STEM degree programs in 2014 and 9.6 percent in 2016 identified as Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander. Based on data release date, FY13 - FY16 NASA data is compared to 2014 NCES-IPEDS; FY17 NASA data is compared to 2016 NCES-IPDES.

OSTEM Student Awards: Ethnicity

	# of Significant Awardees	Not Hispanic or Latino #	(%)	Hispanic or Latino #	(%)	DNR Ethnicity #
FY 2015						
All OSE	3,673	2,848	(83.9)	545	(16.1)*	280
FY 2016						
All OSE	7,519	5,796	(83.3)	1,160	(16.7)*	563
FY 2017						
All OSE	7,409	5,836	(84.2)	1,099	(15.8)*	474

Note: * indicates years that awardees exceeded the national average for Ethnically underrepresented (URE) students enrolled in STEM degree programs.
DNR = Did not report

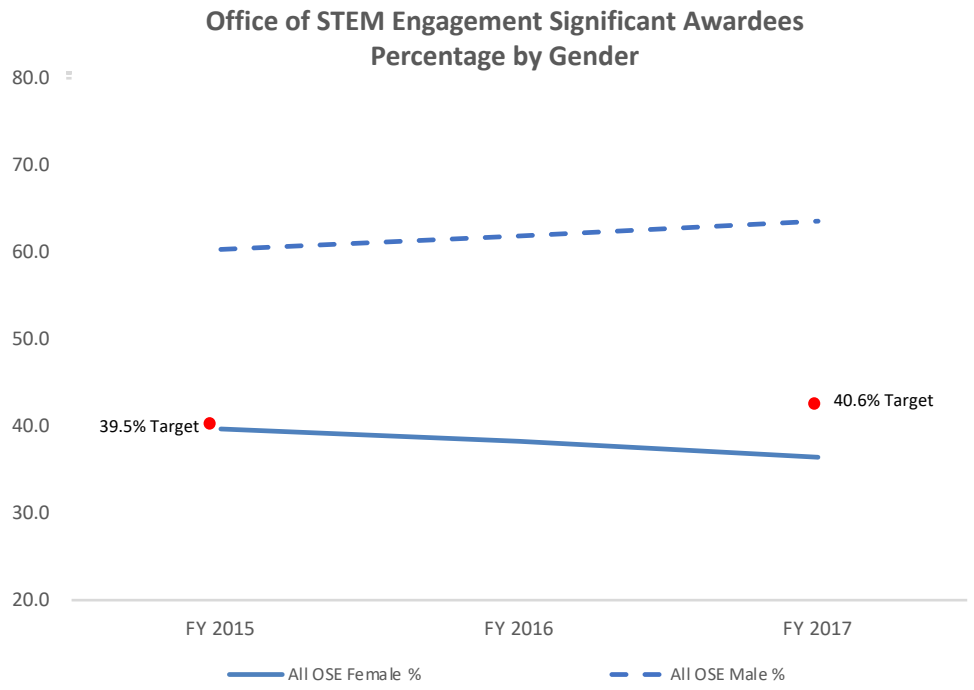


Note: Red dot (●) indicates the national average for Hispanic or Latino students enrolled in STEM degree programs. The U.S. Department of Education's Integrated Postsecondary Education Data System (IPEDS) reported 11.7 percent of enrollees in STEM degree programs in 2014 identified as Hispanic or Latino and 14.4 percent in 2016. Based on data release date, FY16 NASA data is compared to 2014 NCES-IPEDS; FY17 NASA data is compared to 2016 NCES-IPDES.

OSTEM Student Awards: Gender

	# of Significant Awardees	Male # (%)	Female # (%)	DNR Gender #
FY 2015				
All OSE	3,673	2,180 (60.3)	1,434 (39.7)*	59
FY 2016				
All OSE	7,519	4,599 (61.7)	2,849 (38.3)*	71
FY 2017				
All OSE	7,409	4,673 (63.6)	2,678 (36.4)	58

Note: * indicates years that awardees exceeded the national average for female students enrolled in STEM degree programs.
DNR = Did not report



Note: Red dot (●) indicates the national average for females enrolled in STEM degree programs. The U.S. Department of Education's Integrated Postsecondary Education Data System (IPEDS) reported 39.5 percent of enrollees STEM degree programs in 2014 were female and 40.6 percent were female in 2016. Based on data release date, FY16 NASA data is compared to 2014 NCES-IPEDS; FY17 NASA data is compared to 2016 NCES-IPDES.

NAC Recommendation #2:

Spark that Leads to Engagement

Recommendation #2: The Office of STEM Engagement should create a deep and comprehensive document that describes what we know about sparking student interest (spark), STEM engagement, and motivation, and use it to create the foundational evidence for the Office.

Major Reasons for the Recommendation: NASA is uniquely positioned to inspire and motivate the country with their work. As good stewards of a limited budget, NASA strives to maximize its investments. If NASA could better understand spark, STEM engagement, and motivation, it could be more effective—basing investment decisions on evidence of what works. The Committee feels there is sufficient ambiguity in the field about spark, STEM engagement, and motivation that the Agency should invest in a deeper review of the evidence-based strategies and practices that promote spark, STEM engagement, and motivation.

Consequences of No Action on the Recommendation: Lack of action on this recommendation relegates NASA to using secondary indicators of effectiveness, and could lead to less effective investment decisions. NASA will have limited impact, and will be at greater risk of duplication of ineffective activities.

NASA STEM Engagement

1. Key Updates
   - Moon 2024 & National Space Council
   - Strategy & Portfolio
   - MAP Progress

2. Connecting Nation's STEM to NASA's Mission
   - Team II
   - Partnerships
   - NextGen STEM CCP Activities
   - Sparking an Interest in STEM

3. Discussion & Finalize Findings/Recommendations

NAC Recommendation #2: Spark that Leads to Engagement

NAC Recommendation #2	Proposed Approach	Utility
Create a deep and comprehensive document that describes what is known about: Sparking student interest, STEM engagement, and Motivation.	• Engage a panel of nationally recognized STEM education subject matter experts (SME) to develop recommendations for NASA's continued success in STEM engagement. • Convene a Sparking STEM Interest Forum with SMEs at NASA HQ to discuss and prioritize recommendations. • Create a report of STEM education SME findings, recommendations, and next steps for continuing the line of research.	The report will provide foundational evidence that will be used to inform: • NASA's portfolio of STEM Engagement investments and • The design, execution, and performance measurement of NASA's STEM Engagement activities.

OSTEM Portfolio

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 student understanding 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

Sparking student interest, STEM engagement and motivation

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DRAFT QUESTIONS

NAC Recommendation #2

Create a deep and comprehensive document that describes what is known about:

- **Sparking student interest,**
- **STEM engagement, and**
- **Motivation.**

What should NASA do to find success in STEM Engagement?

1. What is the appropriate role in sparking STEM interest for NASA that is unique from other federal agencies? In sustaining STEM interest? In developing and sustaining students' intrinsic motivation to persist in STEM academic and career pursuits?

    - What research-based effective strategies should NASA incorporate into the design and execution of STEM engagement activities to spark STEM interest in diverse student populations, specifically groups traditionally underserved or underrepresented in STEM fields? To sustain STEM interest? To develop and sustain students' intrinsic motivation to persist in STEM academic and career pursuits?

2. To what extent are NASA's goals and priorities for STEM engagement designed to support sparking STEM interest? Sustaining STEM interest? Developing and sustaining students' intrinsic motivation to persist in STEM academic and career pursuits?

3. To what extent is the NASA STEM Engagement Strategy an effective document to guide the design and execution of activities that will spark STEM interest? Sustain STEM interest? Developing and sustaining students' intrinsic motivation to persist in STEM academic and career pursuits?

PHASE ONE KEY MILESTONES

Timeline	Phase One Key Milestones
April 2019	• STEM Education SME's identified
May 2019	• Orientation webinar for STEM Education SMEs • STEM Education SMEs generate abstracts and research prospectus document
June 2019	• STEM Education SME's finalize abstracts and research prospectus • PAEIM Team develops workshop agenda and structure • PAEIM Team completes logistics and travel for staff and STEM Education SMEs for workshop
July 2019	• Convene STEM Education SME workshop at NASA HQ • PAEIM Team generates report of workshop findings
August 2019	• PAEIM Team finalizes report of workshop findings

National Aeronautics and
Space Administration

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THANK YOU!