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**S** **T** **E** **M** **INSPIRE - ENGAGE - EDUCATE - EMPLOY**  
The Next Generation of Explorers



**NASA Advisory Council**  
**Sparking STEM Interest Forum**  
**Findings and Items for Consideration**

October 29, 2019

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# Agenda



- Overview of process
- Summary of primary findings
- Individual discussion of themes
  - Brief list of items for consideration for each theme
- Takeaway message
- Complete evaluation team items for consideration
- Requests for NAC Feedback
- Preliminary next steps
- Questions and feedback



**NAC STEM Recommendation: “Create a deep and comprehensive document that describes what is known about: sparking student interest, STEM engagement, and motivation.”**

Convene a Sparking STEM Interest Forum with a panel of nationally recognized STEM education subject matter experts (SME) at NASA HQ to develop, discuss, and prioritize items for consideration for NASA’s continued success in STEM engagement.

Compile review of the literature on sparking student interest, STEM engagement, and motivation.

Develop a comprehensive report synthesizing results

# Expert Review Panel and Literature Review



## Purpose

The Office of STEM Engagement should create a deep and comprehensive document describing what is known about sparking student interest, STEM engagement, and student motivation.

### Expert Review Panel and Literature Review Themes

Four themes guided the ERP and Literature Review

Sparking STEM Interest

NASA's Role in Sparking STEM Interest

Engaging Diverse Students in STEM

NASA's STEM Engagement Strategy

### Literature Review

- Systematic procedure: search for relevant literature using EBSCO, google scholar, and National Academies Press databases.
- 100+ articles and National Academies sources.

### Expert Review Panel July 24, 2019

- 11 individuals with expertise aligned to areas of discussion
- Professors in Education, Learning, Research, Diversity, and STEM Education
- Representatives from agencies committed to education, research, science, and technology innovation



# NASA Education Evaluation Planning Expert Review Panel

**Dr. Patricia Allen, Research Manager**

The PEAR Institute: Partnerships in Education and Resilience

**Dr. Kenneth Alonzo Anderson, Associate Professor,  
Associate Dean for Research and Sponsored Programs**

Howard University

**Dr. Angela Calabrese Barton, Professor, Department of  
Teacher Education**

Michigan State University

**Dr. Rena Dorph, Director**

The Lawrence Hall of Science

**Dr. Carla C. Johnson, Associate Dean, Executive Director**

North Carolina State University

The Friday Institute of Educational Innovation

**Dr. Adam Maltese, Associate Professor, Center for Research  
on Learning and Technology; Curriculum and Instruction**

Indiana University

**Dr. Sarah-Kay McDonald, Senior Advisor in the Office of  
the Assistant Director, Directorate for Education and  
Human Resources**

National Science Foundation

**Dr. Ebony McGee, Associate Professor of Education,  
Diversity and STEM Education**

Vanderbilt University

**Dr. Carol O'Donnell, Director, Smithsonian Science  
Education Center**

Smithsonian Institution

**Dr. Tim Podkul, Principal Research Scientist, Director  
INCLUDES program**

SRI Education

**Ms. Andrea Simmons, Army Educational Outreach  
Program Director**

Office of the Deputy Secretary of the Army for Research  
and Technology

# Primary Findings



## Sparking STEM Interest

Sparking STEM interest was defined differently by panelists and literature.

### A “spark” is:

- A moment that exposes an individual to a topic and serves as a precursor to engagement
- Involves **Phenomenon Learning**, or examination of phenomena.

### According to Panelists

- A “spark” is not only how interest is triggered, but more importantly how it is maintained.

## NASA’s Role in Sustaining STEM Interest

Panelists disagreed regarding NASA’s role in sustaining STEM interest.

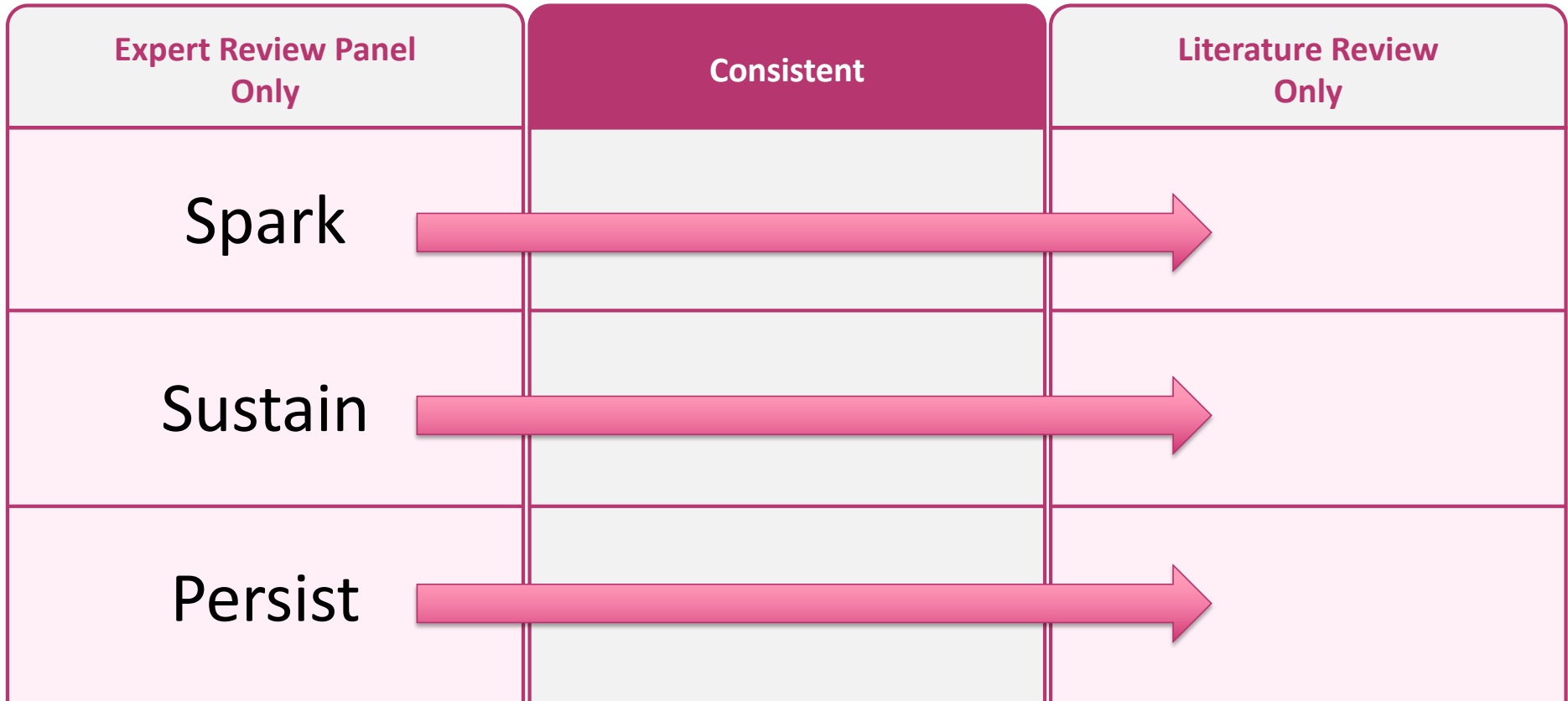
- NASA should take a direct, hands-on role.
- NASA should serve as facilitator to collaborators (e.g., ecosystems, agencies, public entities, and stakeholders) who provide hands-on sustainment efforts.

## Engaging Diverse Students in STEM

Methods for supporting and measuring “spark”, sustainment, and motivation to persist may differ among diverse groups.

- There is no silver bullet.
- More research is needed to better understand differences.
- Strategies and measurement methods may differ by group.

# Layout



# Sparking STEM: ERP & Literature Review Comparison

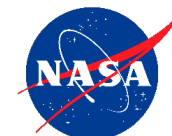


Expert Review Panel Only	Consistent	Literature Review Only
<ul style="list-style-type: none"> <li>Determine audience; revisit discussion with collaborators and students who experience “spark”; have shared definition.</li> <li>“Spark” is not only how interest is triggered, but also how it is maintained.</li> </ul>	<ul style="list-style-type: none"> <li>“Spark” is a moment that exposes an individual to a topic or field and that serves as a precursor to engagement</li> <li>“Spark” involves Phenomenon Learning and helps to develop a STEM identity.</li> </ul>	<ul style="list-style-type: none"> <li>“Spark” has emotional component:                             <ul style="list-style-type: none"> <li>Excitement, wonder, surprise, and comfort</li> </ul> </li> <li>“Spark” is personally relevant.</li> <li>“Spark” should involve interactive learning: students learn by doing.</li> </ul>
<ul style="list-style-type: none"> <li>A lack of engagement does not signify a lack of interest: consider access.                             <ul style="list-style-type: none"> <li>Underserved populations may not have access to engagement opportunities.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Relationship between interest and engagement is complicated: one does not precede or produce the other.</li> <li>Consider engagement in context of support and resources.</li> </ul>	<ul style="list-style-type: none"> <li>Interest develops into engagement through initial excitement and repeated positive experiences. Interest then extends beyond experience, one chooses to engage more.</li> </ul>
<ul style="list-style-type: none"> <li>Relationship between interest and persistence may differ by individual:                             <ul style="list-style-type: none"> <li>“Some may follow interests in STEM; others may see STEM as a practical option for gainful employment.”</li> </ul> </li> <li>Recognize and support different pathways to STEM academic and career pursuits.</li> <li>Facilitate agencies supporting persistence.</li> </ul>	<ul style="list-style-type: none"> <li>Many factors impact whether interest leads to motivation to persist in STEM:                             <ul style="list-style-type: none"> <li>Environment</li> <li>Support system</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>To motivate persistence, reinforce students by asking questions about everyday phenomena.                             <ul style="list-style-type: none"> <li>Leads to curiosity which motivates students to persist in seeking solutions to problems.</li> </ul> </li> </ul>



# Sparking STEM Interest

## Evaluation Team Synthesis Preliminary Items for Consideration



1. NASA should continue to refine the definition of sparking STEM interest in terms of evidence-based characteristics within the context of NASA STEM Engagement.
2. Provide STEM engagement opportunities that are adaptable to the unique needs and contextual factors of various beneficiaries.
3. Continue to invest in opportunities that spark and engage young people.
4. Recognize and support different pathways to STEM academic and career pursuits.
5. Explore how “spark” functions within the system or environment where it was delivered, and continue to provide supports to collaborators that contribute to persistence.

# NASA's Role in Sparking STEM Interest: ERP Feedback Only



Evaluation Question	ERP Feedback
<p>What is the appropriate role in <i>sparking</i> STEM interest for NASA that is unique from other federal agencies?</p>	<p>NASA STEM work is uniquely multidisciplinary, interdisciplinary, AND transdisciplinary. NASA's unique content and amazing stories should be shared widely.</p>
<p>What is the appropriate role in <i>sustaining</i> STEM interest for NASA that is unique from other federal agencies?</p>	<p>Some: NASA's responsibility is to <b>directly</b> sustain interest.</p> <ul style="list-style-type: none"> <li>• <i>"Students know what NASA is... Visibility should be harnessed as a critical component."</i></li> </ul> <p>Others: NASA should facilitate other agencies who will focus on sustaining interest.</p> <ul style="list-style-type: none"> <li>• <i>"NASA is well-positioned in the Federal space to play an important role in sparking interest, and to collaborate with other agencies to sustain STEM interest generally."</i></li> </ul>
<p>What is the appropriate role in developing and sustaining students' intrinsic motivation to persist in STEM academic and career pursuits for NASA that is unique from other federal agencies?</p>	<p>For "spark" to promote motivation to persist, the system must provide support along the way.</p> <ul style="list-style-type: none"> <li>• Diversify expectations by level: give greater responsibility and opportunities as students progress.</li> </ul> <p>NASA's role is to use relationships and branding to convene appropriate partners pertinent to the STEM ecosystem of interest who will promote persistence.</p>

# NASA's Role in Sparking STEM Interest

## Evaluation Team Synthesis Preliminary Items for Consideration



1. NASA should intentionally build and test models of transdisciplinary learning that leverage unique mission assets.
2. NASA should continue to operationalize its role in the STEM ecosystem in relation to the sustainment of spark incorporating feedback from the ERP, literature review, recent evaluations, and internal stakeholder discussions.

# Diversity in STEM: ERP & Literature Review Comparison



Expert Review Panel Only	Consistent	Literature Review Only
<ul style="list-style-type: none"> <li>• <b>Boldly target underserved and underrepresented communities.</b></li> <li>• <b>Offer engagement activities digitally / virtually and at libraries and churches.</b></li> <li>• <b>Match role model's key identity to students.</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Provide materials and opportunities that help diverse students develop STEM identity.</b></li> <li>• <b>Offer personally relevant materials.</b> <ul style="list-style-type: none"> <li>• Involve members of diverse populations in creation and execution of NASA materials.</li> </ul> </li> <li>• <b>Make diverse role models available.</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Multiple diverse role models are better than one "perfect" role model.</b></li> </ul>
<ul style="list-style-type: none"> <li>• <b>Perform <u>targeted</u> efforts to sustain interest in underserved /underrepresented students.</b></li> <li>• <b>Facilitate connections with collaborators and ecosystems that sustain interest.</b></li> <li>• <b>Provide mentors with shared key identities.</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Help students maintain STEM identity.</b> <ul style="list-style-type: none"> <li>• Diverse mentors help with sustainment.</li> </ul> </li> <li>• <b>Focus on local aspects of STEM.</b></li> <li>• <b>Engage students in phenomenon learning and provide choice or autonomy.</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Promote personal relevance in STEM.</b></li> <li>• <b>Present appropriately challenging material.</b></li> <li>• <b>Situate investigations in socially and culturally appropriate contexts.</b></li> </ul>
<ul style="list-style-type: none"> <li>• <b>Make efforts to reduce challenges faced:</b> <ul style="list-style-type: none"> <li>• Fund continued support.</li> <li>• Provide students with mentors with similar key identities.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <b>Help students from diverse populations develop self-efficacy and STEM identity.</b> <ul style="list-style-type: none"> <li>• Make careers in STEM personally relevant.</li> </ul> </li> <li>• <b>Show STEM in many situations and contexts.</b> <ul style="list-style-type: none"> <li>• Make STEM local, identify non-traditional practices, and celebrate diversity in STEM.</li> </ul> </li> <li>• <b>Reduce challenges students face:</b> <ul style="list-style-type: none"> <li>• Support transitions.</li> <li>• Provide diverse mentors.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <b>Offer supports and guidance along the way as students transition.</b></li> <li>• <b>Provide a variety of diverse mentors.</b></li> </ul>

# Diversity in STEM

## Evaluation Team Synthesis Preliminary Items for Consideration



1. NASA should continue to work with collaborators and ecosystems, leveraging its diverse role models and local stakeholders, to facilitate development and implementation of materials and activities that spark and sustain STEM engagement in underserved and underrepresented communities.
2. NASA should develop communication campaigns and strategies to promote personal relevance and connections to NASA's missions in local communities.
3. NASA should develop and test a wide range of strategies that identify how to make NASA and careers in STEM accessible and relevant to diverse audiences.

# Takeaway Messages



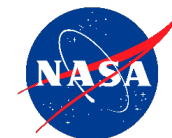
This report reaffirmed a number of key

- 1) The importance of diversity
- 2) The benefit of mentors and role models
- 3) The need to engage customers in product and activity development

The report also highlighted areas where further discussion and final determinations are needed within NASA and in coordination with collaborators:

- 1) Concretize and operationalize the definition for “spark” in alignment to NASA goals and strategy
- 2) Establish NASA’s role in sustainment
- 3) Determine how best to provide opportunities to numerous diverse groups

# List of Items for Consideration



1. **NASA should continue to refine the definition of context of NASA STEM Engagement.**
2. Provide STEM engagement opportunities that are adaptable to the unique needs and contextual factors of various beneficiaries.
3. Continue to invest in opportunities that spark and engage young people.
4. Recognize and support different pathways to STEM academic and career pursuits.
5. Explore how “spark” functions within the system or environment where it was delivered, and continue to provide supports to collaborators that contribute to persistence.
6. NASA should intentionally build and test models of transdisciplinary learning that leverage unique mission assets.
7. **NASA should continue to operationalize its role in the STEM ecosystem in relation to the sustainment of spark incorporating feedback from the ERP, literature review, recent evaluations, and internal stakeholder discussions.**
8. NASA should leverage its diverse role models and local stakeholders to further develop relevant materials and strategies that spark interest in underserved and underrepresented beneficiaries.
9. NASA should develop communication campaigns and strategies to promote personal relevance and connections to NASA’s missions in local communities.
10. **NASA should continue to work with collaborators and ecosystems, leveraging its diverse role models and local stakeholders, to facilitate development and implementation of materials and activities that spark and sustain STEM engagement in underserved and underrepresented communities.**
11. NASA should develop and test a wide range of strategies that identify how to make NASA and careers in STEM accessible and relevant to diverse audiences.

# Requests for NAC Feedback



- Of the complete list of items for consideration, which do you see as those we may want to focus on?
  - Where do you believe we can make the greatest impact?
- Where do you see alignment between the presented items for consideration and your own experiences or observations?
- What are your thoughts on NASA's role related to the sustainment of spark?
  - From your experiences, what strategies and best practices for sustainment would you suggest NASA consider adopting or exploring?





## Questions and Feedback