NASA Advisory Council Science, Technology, Engineering and Mathematics (STEM) Engagement Committee

Notes

October 29, 2019
12:00 noon – 4:30 pm ET
VIRTUAL MEETING

STEM Engagement Committee Members
Dial-in Participants: Norman Fortenberry, Michael Lach, Ray Mellado, Darryl Williams, Daniel Dumbacher, Acting Chair
Not Participating: Cristin Dorgelo, Carl Person, Aimee Kennedy, Chair

Others Participating:
Beverly Girten (Executive Secretary), Michael Kincaid, Kris Brown, Diane DeTroye, NASA HQ Office of STEM Engagement; Rob LaSalvia, Anne Gooding, Glenn Research Center

Opening Comments
Dr. Beverly Girten, Committee Executive Secretary welcomed everyone and noted the meeting is a virtual meeting taking place in accordance with the Federal Advisory Committee Act (FACA). Mr. Dumbacher offered introductory comments noting it is imperative of the STEM Engagement Committee to do everything possible to help get the next generation prepared for the future. NASA is in a unique position to inspire generations to come. Members then introduced themselves.

National STEM Updates
Federal Coordination (FC) in STEM
Mr. Kincaid reviewed the Federal STEM Education Strategic Five-Year Plan and introduced the Federal Coordination in STEM Education Task Force (FC-STEM) topic. FC-STEM is chaired by Mike Kincaid, NASA Associate Administrator for STEM Engagement and Karen Marrongelle, National Science Foundation Assistant Director for Education and Human Resources. Mr. Kincaid reviewed the three objectives from the federal strategic plan that NASA selected to support: 1.) Foster STEM ecosystems that unite communities; 2.) Increase work-based learning and training through educator-employer partnerships; and 3.) Encourage transdisciplinary learning. While NASA may support other strategic objectives, they are not as heavily invested in them. NASA has resources committed and people identified to support the chosen objectives.

Office of STEM Engagement (OSTEM) Updates
Overview/Budget/Matching Investments/Congress/Artemis
Mr. Kincaid provided an update on the evolution of the Office of STEM Engagement and discussed NASA's contribution to America's STEM ecosystem. NASA STEM Engagement fits within the cross section of: NASA and aerospace workforce needs; NASA mission needs; students and educational institutions; and United States STEM challenges. NASA's mission allows NASA to play a unique role that other agencies cannot. Mr. Kincaid highlighted NASA's alignment with the Office of Science Technology Policy and the Office of Management and Budget priorities, specifically the priority for space exploration and commercialization. The priority cross-cutting action to support space exploration and commercialization is to build and leverage a diverse and highly skilled American workforce. The NASA STEM Engagement strategy focus area which supports this action is focus area two, to build a diverse future STEM workforce.

Mission Support Future Architecture Program (MAP) and Sphere 1 Activities
Connecting Nation's STEM to NASA's Mission
Ms. Kris Brown reviewed the process for how the Office of STEM Engagement is driving agency work in STEM Engagement to align with NASA's three focus areas for STEM engagement and drive outcomes. Office of STEM Engagement defines the Agency work in STEM engagement for this fiscal year. This includes what is planned within the Office of STEM Engagement program ($110M) and the remainder of what the Agency is doing in STEM engagement, which falls mostly within the realm of the Mission Directorates.

Ms. Brown then discussed the drivers of and contributions to the Agency STEM Engagement portfolio. Mission Directorates strategically select a portion of their work to engage students. They then engage STEM practitioners to engage students. That has been happening across the Agency over many years.

The Office of STEM Engagement also engages students in NASA's work. These efforts are pulled together to comprises the NASA STEM Engagement Portfolio. Office of STEM Engagement piloted an annual planning cycle in FY 2019 that will go forward FY 2020. The planning cycle looks at what works for students as a way to develop a frame for the portfolio to engage students in NASA's work.

Office of STEM Engagement looked at a snapshot of 94 discrete STEM Engagement activities across the Agency. Forty-three (43) were from the Office of STEM Engagement and most of the remainder were from Mission Directorates. Office of STEM Engagement conducted a comprehensive analysis of these activities for alignment with STEM Engagement focus areas and strategic objectives and identification. STEM Engagement also identified the beneficiary group for each activity. Activities that reached students were included in the analysis. Activities that leaned more toward public engagement were not included. These 94 activities were then prioritized according to four design principles and criteria. Through proposal and deliberation with the STEM Engagement Council, five activities were identified as Sphere 1 activities for FY 2020. These are: Artemis STEM challenges; International Space Station 20th Anniversary;

Commercial Crew; Earth Day; and Mars 2020. Sphere 1 activities are based on high level Agency priorities and will drive high priority activities. Office of STEM Engagement will leverage the attention placed on NASA priorities to reach students.

Mr. Dan Dumbacher noted that the five Sphere 1 activities did not include Aeronautics Research Mission Directorate content. Ms. Brown noted no aeronautics activities were brought forward for Sphere 1. While Office of STEM Engagement strives to be equitable across Mission Directorates each year, no aeronautics activities with a high level of magnitude were brought forward. Not every Mission Directorate will be highlighted each year but will be across years.

Mr. Kincaid then discussed Sphere 1 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; and STEM Engagement content is consistent and streamlined.

Dr. Norman Fortenberry asked if STEM Engagement is considering partnership with other organizations or universities to tie students into some their research. Mr. Kincaid noted they are open to many possibilities. The STEM Engagement Council is coming together for one and a half days and will be discussing how to handle the Sphere 1 activities. There is a strong potential for partnerships.

Mr. Kincaid also noted that the Sphere 1 activities are not Office of STEM Engagement investments. For example, the Artemis challenges are largely funded by the Human Exploration and Operations Mission Directorate.

Mr. Kincaid noted they are looking for ways to better involve Mission Directorates in Space Grant. Space Grant is the largest part of the STEM Engagement portfolio. Office of STEM Engagement will be looking at cost-sharing opportunities, ways to tap into the vast network of Space Grant partners, and how to involve Space Grant in the Artemis STEM Challenges. Space Grants are on college campuses and can provide insight on how to attract students. Office of STEM Engagement continues to look for ways that to enable the mission.

Mr. Dumbacher asked how the portfolio links to the budget. Mr. Kincaid responded that a previous complaint from other federal offices was that Office of STEM Engagement could not demonstrate the progress or success of what they were doing. Since then, Office of STEM Engagement has been intentional in showing how activities link to the mission. During the last NASA Advisory Council (NAC) meeting Human Exploration and Operations Mission Directorate and the Office of STEM Engagement looked at how the mission directorate efforts fit with STEM Engagement. Mr. Kincaid will be meeting with the NAC Human Exploration and Operations Committee to show linkages between the two communities and build advocacy for the budget.

Dr. Darryl Williams, referencing the drivers and contributions slide, asked about the feedback from research and evaluation. Dr. Williams suggested while there is a feedback from the

portfolio to the mission goals, there should also be a feedback to the STEM Engagement goals and requirements. Ms. Brown responded they welcome feedback on the strategy and acknowledged the feedback to STEM Engagement makes sense. Mr. Kincaid added they have received positive comments from Office of Management Budget on their evaluation process.

Mr. Ray Mellado commented that he is looking at it from the perspective of a high school or college student looking for guidance on careers that will be developing in the next five to ten years that will relate to NASA and NASA alone. That would create interest among teacher and professors.

Ms. Brown added the strategy is to think in partnership with industry partners and look at workforce needs. Partnership with industry helps identify what are the needs in the industry and what types of experiences NASA can offer students to bring them into the pipeline.

Mr. Mellado commented teachers from the Great Minds in STEM conference were trying to visualize where this technology is going to with NASA leading us into space. Mr. Kincaid noted they are looking at early career professionals to talk about what they are doing to contribute to Artemis and act as role models for students.

National Survey of Science and Mathematics Education

Mr. Rob LaSalvia reviewed the findings of the 2018 National Survey of Science and Mathematics Education released by Horizon Research. This report is the sixth in a series funded by the National Science Foundation. The survey findings are provided in a comprehensive report with data and tables on K-12 science and math education across the country. The 2018 survey added computer science. Selected findings presented by Mr. LaSalvia address teacher preparedness, access to opportunity, instructional dosage, use of effective practices, and experience.

Mr. Dumbacher asked where to get a copy of the report. The report is found here: http://horizon-research.com/NSSME/2018-nssme/research-products/reports

STEM Partnerships/Apollo 50th Anniversary/Next Gen STEM

Dr. Bev Girten provided an overview of STEM Engagement Space Act Agreement partnerships across the Agency and highlighted notable partnership achievements in FY2019 including partnerships with Microsoft, Department of Education, Tynker, Peanuts Worldwide and Challenger Center. She also showed how partnership activities fit into the overall Office of STEM Engagement strategy.

Ms. Diane DeTroye reviewed the budget line item for NextGen STEM which Includes investment in three Next Gen STEM pilot themes (Artemis, X-59 Quest Low Boom Flight Demonstration, Commercial Crew), museums and the Texas state cooperative agreement for educator professional development. In 2018-2019 Next Gen STEM emphasized architecture—starting with the mission and how it reaches the beneficiary. They are engaging middle school students in mission content through the Next Gen STEM themes. She also noted a large investment in aeronautics through the X59 Quest activities. Activities are developed through the STEM

Engagement strategy design principles. The first year is under development and they look to 2020 to refine product and enable broader dissemination. Ms. DeTroye then highlighted how Next Gen STEM ties back to the Sphere 1 activities and highlighted activities from the Apollo 50th celebration. Ms. DeTroye highlighted the Microsoft partnership on Hacking STEM Lessons which began 2018. The lesson plans are aligned to standards and present concepts and challenges associated with spaceflight. Using the Astrosocks challenge as an example, Ms. DeTroye illustrated how students are engaged in solving a Mission Directorate problem. Astronauts develop callouses on top of their feet as they lock into footholds. Astrosocks is an engineering design activity that challenges students to help find a solution to this problem.

Ms. DeTroye discussed the Peanuts Worldwide partnership, where NASA verified STEM lessons, and an upcoming partnership with Apple TV, where NASA will serve as a subject matter expert to ensure correct representation of NASA content.

Next Gen STEM conducted an expert review panel in July 2019 on the pilot themes. The emphasis was on focusing on the NASA work while meeting the educational needs. Next Gen STEM is working through the recommendations for improvement. There is a tension between short activities that can be quickly used in the classroom with longer, problem based learning activities. They completed the evaluation of the pilot themes and presented them in a multiple case study report.

Mr. Dumbacher asked if there are teachers on staff that have been helping with this work. Ms. DeTroye noted that they have former classroom educators on the Paragon Tech contract.

Sparking Interest in STEM

Dr. Anne Gooding provided an update on the Sparking an Interest in STEM study undertaken by Glenn Research Center. This study was a result of an action from a previous NAC STEM Engagement Committee meeting after the NASA Administrator commented on the importance of NASA 'sparking student interest in STEM'. Dr. Gooding reported they convened a Sparking Interest in STEM panel at NASA HQ and conducted a literature review and synthesized the outcomes into a comprehensive report. Dr. Gooding shared four themes that guided the expert panel review: sparking STEM interest; NASA's role in sparking STEM interest; NASA's STEM Engagement strategy; and engaging diverse students in STEM. Panelists agreed NASA should use brand recognition to provide STEM opportunities. After a detailed summary of the findings and a comparison of the expert panel and literature review, Dr. Gooding indicated the study reaffirmed three key focus areas in NASA's STEM Engagement strategy: the importance of diversity; the benefit of role models and mentors; and the need to engage customers in product and activity development. The report also highlighted three areas for NASA to continue discussing before final determinations are made. The Glenn team highlighted four suggested items to focus on and asked the committee for input on those four items. Dr. Gooding also noted that the expert panel disagreed on NASA's role in sustaining STEM interest. Some panelists felt NASA should have a direct role, whereas others felt NASA should serve as a facilitator to collaborators. Mr. Mellado commented that it does not have to be an either or, but that NASA's role could be both.

Dr. Gooding asked the committee for feedback on three questions. The first question is "Of the complete list of items for consideration, which do you see as those we may want to focus on?" Dr. Williams asked if the three objectives NASA STEM Engagement selected from the five-year Federal strategic plan are the ones that should be highlighted on the list. That is, use the three objectives as the lens or filter by which the three items on the list are chosen. Dr. Lach and Dr. Fortenberry agreed with that approach. The committee noted that defining metrics to identify and measure progress on each of the items was not included and questioned how NASA STEM Engagement knows they are reaching the right people. Dr. Gooding responded that the Glenn group concluded that they can't measure anything until they know what they are measuring which is why item 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," was highlighted. The committee noted the metrics ought to tie back to objectives. Mr. Kincaid then commented that the federal five-year plan contains another aspect for transparency and accountability that all agencies were to look at. In essence NASA has four objectives to address. The committee also noted that some items on the list could be collapsed down and that others build on each other. Some actions must be completed before others could be undertaken.

Dr. Gooding then presented the second question, "Where do you see alignment between the presented items for consideration and your own experiences or observations?" Mr. Dumbacher noted the findings from the expert panel and literature review is consistent with what is observed in the professional society world. American Institute of Aeronautics and Astronautics (AIAA) has a foundation board that asked them to impact one million students per year. AIAA is working to figure out what impact means and how to develop the metrics. Dr. Fortenberry noted that to him the list of items for consideration are not independent, for example, item eight is a subset of item two. There are dependencies between some of the items. Dr. Gooding confirmed there are overlaps between some of the items. Dr. Gooding then presented the third question for feedback: "What are your thoughts on NASA's role related to the sustainment of spark?" Mr. Dumbacher stated that input from corporate members of professional organizations is to emphasize academic community and the interdisciplinary and transdisciplinary nature of engineering problems. We need to work harder to get out of traditional engineering stovepipes and into transdisciplinary approaches. Dr. Williams noted NASA is uniquely positioned to facilitate that kind of work and that NASA should lean into that opportunity. Mr. LaSalvia confirmed the expert panel had offered the same perspective.

Discuss/Finalize Findings and Recommendations

The STEM Engagement Committee (Committee) continued discussions and agreed upon one recommendation and two findings:

> **Recommendation 1: STEM Integration Across Agency**
> The Committee greatly appreciates how the Office of STEM Engagement (OSTEM) is working to increase understanding among Mission Directorates and Centers via the STEM Engagement Council. The Committee also recognizes the challenges of this effort

and the additional work necessary to identify potential improvements.

The Committee recommends additional efforts at cross fertilization and understanding among the NAC Committees on the STEM activities across the Agency. The Committee clearly sees a need for a more thorough understanding of the current goals, objectives, and status among the Mission Directorates and Centers concerning STEM activities and how these activities support the Agency meeting the goals and objectives of the Federal 5-Year STEM Strategic Plan.

Rationale

- To assure NASA meets its commitments to the Federal 5-Year STEM Strategic Plan and efficient use of NASA / STEM resources for maximum impact toward the Federal 5-year STEM Strategic Plan
- Consequences of no action can drive a lower probability of NASA achieving goals of the Federal 5-year STEM Strategic Plan. Lack of action also results in uncoordinated messaging and status among the various Mission Directorates and Centers on STEM activities and further confusion among STEM participants and implementation staff.

Finding 1: Study on Sparking Interest in STEM

The Committee appreciates the work done to understand the generation and sustainment of "sparking" interest in STEM areas. The expert panel review and literature search provided valuable input to STEM Engagement Strategies. The "Spark" study conducted by OSTEM provides important knowledge and information for future STEM activities planning. The Committee looks forward to seeing the results of the action requesting OSTEM to develop a prioritization strategy for addressing the findings from the Spark study, at a future Committee meeting.

Finding 2: STEM Alignment and Diversity

The STEM Committee applauds the effort to develop the direct correlation of OSTEM objectives to the Federal 5-year STEM Strategic plan. This effort leads to an architecture enabling student opportunities in STEM activities based on results from the Spark study.

As OSTEM proceeds with the on-going planning effort the Committee would like the opportunity to review the resulting relationship of OSTEM activities to the overall Federal plan and asks that OSTEM provide direct evidence demonstrating the direct support of the 5-year Federal STEM Strategic Plan. The Committee supports OSTEM's plan to provide evidence of utilizing intentional activities and methods for assuring STEM activities reach the diverse, under served and underrepresented communities. The Committee also feels that metrics would be valuable to measure the results for reaching out to new communities.

Adjourn Meeting

Dr. Girten then adjourned the meeting.