

**APPROVED MINUTES
PLENARY OPEN SESSION
476TH MEETING
NATIONAL SCIENCE BOARD**

National Science Foundation (NSF)
Via Videoconference
December 8 - 9, 2021

Members Present:

Ellen Ochoa, *NSB Chair*
Victor McCrary, *NSB Vice Chair*
Sudarsanam Babu
Roger Beachy
Arthur Bienenstock
Maureen Condic
Aaron Dominguez
W. Kent Fuchs
Suresh Garimella
Dario Gil
Melvyn Huff
Steven Leath
W. Carl Lineberger
Matthew Malkan
Emilio Moran
Julia Phillips
Dan Reed
Anneila Sargent
Scott Stanley
Stephen Willard
Heather Wilson

Sethuraman Panchanathan, *ex officio*

Members Absent:

S. Alan Stern

There being a quorum, the National Science Board (NSB, Board) convened in Open Plenary Session at 12:45 p.m. on Wednesday, December 8, 2021, via videoconference with NSB Chair, Ellen Ochoa, presiding.

NSB Chair's Opening Remarks

Ochoa welcomed everyone to the NSB's 476th meeting. She began the meeting by stating that the Board, building on the August 2021 pilot, held all committee meetings in advance of the Board meeting and that this meeting would be exclusively in plenary sessions with committees sharing report outs and leading discussions with the full board in both open and closed plenary sessions.

Ochoa outlined briefly some highlights of the agenda. Ochoa then turned the meeting over to NSF Director Sethuraman Panchanathan.

NSF Director's Remarks

NSF Director Panchanathan began by reflecting on Thanksgiving and thanked the NSF staff for moving forward with the agency's priorities, mission, and goals and for the partnership with NSB staff. He commented that he began his term as Director while the agency was working in this virtual mode and after a year and a half he is starting to come into the office more regularly with precautions.

Panchanathan then provided a legislative and budgetary update. On June 8, 2021, the Senate passed the U.S. Innovation and Competitiveness Act (USICA) and on June 28, 2021, the House passed the National Science Foundation for the Future Act. On November 19, 2021, the House passed its Build Back Better Act, which proposes an investment in NSF in the amount of \$3.5 billion for the Technology, Innovation, and Partnerships (TIP) Directorate, core research, infrastructure, and capacity building at historically black colleges and universities and minority serving institutions. The Senate is expected to take up the bill later in December. Finally, he reported that the House and the Senate passed a continuing resolution to keep the government funded through February 18, 2022.

Using a series of slides, (DocLog# NSBO-1918952038-3673) Panchanathan presented an update on the agency's three major priorities: Strengthening Established NSF, Inspiring Missing Millions, and Success of the Technology, Innovation and Partnerships Directorate. The Director provided several examples of long-term NSF investments in fundamental research across various scientific disciplines community, impacts of those investments, and how NSF will continue to invest and expand the frontiers of knowledge and technology. He highlighted several recent Nobel Prize winners and their connection to NSF-funded research through the years. He also presented several examples of how investments lead to impacts in the field of Applied Economics such as establishing a new computer tracking system for kidney donors, increasing the number of people saving for retirement, studying ways to increase higher education enrollment among low-and moderate-income families and exploring the function and design of water markets.

Panchanathan transitioned to talking about the importance of developing future scientists, engineers, and entrepreneurs who are currently in schools and universities. His presentation highlighted some of the programs in which NSF invests to expose underrepresented groups to

science and technology and connect them with mentors and role models in STEM fields. He described his visits to Ohio State University, Oklahoma State University's Unmanned Systems Research Institute, and Johnson Community College. He also visited Blue Valley Center for Advanced Professional Studies, a high school in Kansas that connects high school students with industry, and spoke with students, faculty, and government representatives about NSF's role in supporting innovation and fostering partnerships.

Panchanathan noted the importance of partnerships and described them as a way to activate the cycle of discovery innovation and to supercharge research outcomes. The Director shared some of his efforts since August to establish and maintain partnerships including through conversations with the President's Council of Advisors on Science and Technology (PCAST), Second Nature, and the University of Wyoming President Ed Seidel, and speaking engagements at Research America, the U.S. Naval Academy Science and Engineering Conference, and alongside Ellen Ochoa at the National Academy of Inventors.

Cool Science

Panchanathan introduced "Cool Science", a segment that was introduced during the October 2021 Retreat and consisted of brief examples of NSF-funded science presented by NSF Assistant Directors.

Alexandra Isern, Assistant Director for Geosciences, presented information about innovations that help determine the oceans' role in regulating carbon dioxide ("Discovering the "Breathing" Southern Ocean").

Margaret Martonosi, Assistant Director of Computer and Information Science and Engineering, presented research contributing to the field of computational photography and digital imaging ("Seeing the Unseeable: Computational Photography and Digital Imaging")

Arthur Lupia, Assistant Director, Social Behavioral and Economic Sciences, presented two examples of how researchers make important discoveries and then find a way to empower people to solve a problem ("How Can We Improve Quality of Life?")

Panchanathan concluded his remarks by thanking Arthur (Skip) Lupia and Suzi Iacono for their service and wished them well in their future endeavors (Iacono retired in September 2021). He ended the session with a short video highlighting discoveries made possible by NSF-funded research through 2021.

Session 2 (December 8, 1:50 p.m. – 3:10 p.m.)

Uneven Geography in K-12 STEM Education

NSB Chair Ochoa invited NSB Chair of External Engagement Suresh Babu to introduce NSB member Roger Beachy who then introduced the panel and begin the session. Beachy reminded the Board that NSB's *Vision 2030* calls for a strong workforce, which depends on a STEM

education that begins in grade school. In addition, he reminded the Board that K-12 education indicators show continued poor performance in math and science and that race and ethnicity , in addition to geography, play a role in equitable access to quality STEM education. He finished by introducing the panelists: Pam Buffington, US Division Director of Rural STEM Initiatives at the Education Development Center; Brandy Huderson, Assistant Professor at the University of the District of Columbia; Eric Jolly, President and Chief Executive Officer of the Saint Paul & Minnesota Foundation; and Michael Guarraia, an Albert Einstein Distinguished Educator Fellow at NASA. Each speaker gave a five-minute presentation.

Buffington highlighted the richness of rural communities and how that can be leveraged to improve STEM education, namely through using experiential learning models, embracing multigenerational connections to the school as community centers, and building on the inherent STEM work that many in rural communities already use. Buffington highlighted the need for culturally responsive practices, innovative recruitment/retention strategies, increased STEM collaborations between rural educators and community members, targeted funding for rural higher education access to community colleges, increased funding for technology and connectivity, and a focus on climate change which disproportionately impacts rural communities. Finally, Buffington urged the Board to reframe the narrative so often employed when discussing the culturally, racially, and ethnically diverse 9.3 million students who attend rural schools and their communities.

Huderson defined public urban education as learning centers that exist in metropolitan areas with a tendency for increased cultural/ linguistic and socioeconomic diversity, large enrollment, and large student-to-teacher ratios. Urban populations may be diverse along one or more of these axes and collectively include over 15 million students. Barriers in urban settings include lack of cohesive funding at national and local levels, lack of resources, few professional development opportunities for teachers, and cultural and psychological barriers. The latter can include lack of familiarity with culture/language of student body, lack of culturally relevant curriculums, and preconceived ideas of student desire and ability to learn resulting in lower expectations from educators leading to negative student self-assessments. To mitigate these barriers, Huderson focused on after-school programs that provide place-based, experiential learning and culturally relevant, student-based curriculum, inclusive STEM schools, and bridge programs between high school and college.

Jolly highlighted three common focal points for successful programming – student engagement, student STEM identity, and capacity building in curriculum, resources, and teachers. He highlighted studies showing that students who engage in out-of-school STEM programming boosted career knowledge, interest in STEM, and sense of efficacy by over 70% and increased their math and science proficiency by 20-50%. Although the average expenditure per student is \$1,800, cost remains a barrier for many low-income families - a median family can afford less than 3 weeks of STEM engagement. Accessibility is further compounded by access to transportation and availability of STEM programs. The COVID-19 pandemic has exacerbated access to STEM programs. Finally, Jolly emphasized that the single most important trait in

effective out-of-school programming is time: effective programming must have a minimum of 4 weeks of student interaction.

The panel concluded with Guarraia who described the positive impacts of place-based learning in STEM education, by highlighting two programs: (1) The impact the Chesapeake Bay has had on his curriculum development as a Baltimore-based public and private school STEM educator and (2) work on the Mosquito Habitat Mapper – a citizen science program he worked on that paired geographic location with data collection and tracking of mosquito-borne disease in the students’ own communities. Place-based education requires teacher professional development with a focus on cultural competencies, time for curriculum development, and space for educators to have creative freedom. Guarraia emphasized that “place-based education should provide an opportunity for an immersive learning experience and a connection to the community,” and increase a student’s community connection and increase local stewardship – all of which are likely to increase support and value of local STEM education.

During the question-and-answer session, NSB members explored out-of-school programming success dependency on providing more time for STEM, altering the pacing of materials to match student interests, and developing culturally-centered curriculum. The Board delved further into understanding that culturally relevant curriculum is not changing facts, but rather providing examples to experiences that are relatable to students and giving teachers the training to provide space for their students to bring different approaches to problem-solving. NSB members also discussed, scaling of out-of-school programs, partnerships between school districts and higher education institutions and industry, broadband access, viable STEM pathways for students, teacher quality, and policy recommendations to improve K-12 STEM education nationally.

Chair’s Activity Summary

Ochoa continued the meeting by providing a summary of her activities since the August 2021 meeting. On November 1st, she spoke at the National Academy of Inventors (NAI) where she shared highlights of the Board’s *Vision 2030* report, key actions over the past year, and where the Board is headed. She outlined the Board’s roadmap, focus areas, and emphasized the importance of developing STEM talent at all education levels, and how all members of the science and engineering community must do more to recruit and retain particularly those in underrepresented groups in STEM. During the NAI presentation, Ochoa also highlighted the alignment between *Vision 2030*, the NSF’s vision, and the Administration’s priorities.

Session 3 (December 8, 4:40 p.m. – 5:35 p.m.)

Committee on Science and Engineering Policy Report and Discussion

Ochoa welcomed everybody back to the meeting and turned the floor to Julia Phillips, Chair of the Committee on National Science and Engineering Policy (SEP) for a committee report.

Phillips reported that SEP met in open session on Monday, November 29, 2021, where committee members discussed the Board's *Indicators* messages draft document and a second draft document on the financial barriers that STEM doctoral students face with a focus on the Missing Millions and those from low socioeconomic backgrounds.

Since August, the Board has published three *Indicators 2022* thematic reports namely, *The STEM Labor Force of Today: Scientists, Engineers, and Skilled Technical Workers*; *Academic Research and Development*; and *Publications Output: U.S. Trends and International Comparisons*. The Board also voted to approve the *Higher Education in Science and Engineering* thematic report planned for release in February 2022. Phillips noted that soon after this meeting, the *Invention, Knowledge Transfer, and Innovation* report would be sent to Board members for final approval. The final thematic reports of the 2022 cycle would be sent to Board members for review in the winter and spring with planned releases through May 2022.

Phillips then turned to *The State of the U.S. Science and Engineering*, commonly referred to as the Summary Report. She noted that the summary report would be delivered to Congress on January 18, 2022. Phillips explained that for the first time the Board would also distribute a companion document, both electronically and in print, titled the *U.S. is a Keystone of Global Science and Engineering*. This companion document will complement the policy-neutral Summary Report with the Board's key messages related to *Indicators* data. In past cycles, the policy messages were discussed during the *Indicators* rollout presentations but were not captured in a single document that could be disseminated easily to stakeholders. This policy messages document reflects *Vision 2030* priorities while bringing forward updated key data from *Indicators*. The central message is the importance of strategic sustained U.S. focus on key areas: developing, attracting, and retaining diverse domestic and international STEM talent; critical technologies; basic research; partnerships; and collaboration. These are necessary to ensure that the U.S. holds and strengthens its position as a keystone of the global science and engineering ecosystem. NSBO staff member Reba Bandyopadhyay displayed the companion document on screen for all to view and Phillips opened up the floor for discussion and feedback from Board members. Phillips said that feedback would be incorporated along with NSB's media contractors continued design work to ensure readability and that it visibly echoes the *Vision 2030*. Phillips alerted Board members to expect an email vote before the end of the 2021 calendar year.

Next, Phillips turned to the draft content of the policy companion document, highlighting the running theme of the importance of STEM talent. Phillip described the contents of the document, which centers on nurturing domestic talent including all demographics, socioeconomic statuses, geographies, and education level. The emphasis of the narrative is on the need for stronger K-12 STEM education and financial support to increase access to higher education for all. At the November 29, 2021 SEP meeting, discussion included the importance of addressing barriers to STEM entry associated with low socioeconomic status and the need for that issue to be more clearly featured in this document without losing focus on the Missing Millions. The draft provided to the members ahead of this meeting was revised to thread that issue throughout alongside the data on sex, race, and ethnicity. Feedback from NSF leadership and the nurturing talent team is also reflected in this draft. Phillips added that after the release of *Indicators* SEP would explore what data there is to better understand how disparities in socioeconomic status

impact participation in STEM education and careers with a particular eye to broadening the geography of innovation. Phillips asked Board members for their feedback.

Ochoa offered that the companion document was a good summary of what is included in *Indicators*. Phillips responded that it is clear there is much more that needs to be said and it is challenging to keep it brief. Going forward, working with NCSSES and the Board office, the NSB should identify areas where subsequent documents can amplify issues that the Board wants to hit harder. No additional feedback was offered.

Phillips turned to policy products and said that SEP has been working on a number of them, some already published such as the K-12 education one-pager and more recently one on the topic of nurturing domestic science and engineering talent. Phillips recognized NSB members Suresh Babu, Arthur Bienenstock, and Suresh Garimella for their leadership and engagement on this item and added that this is the first of many more policy pieces to come. She was excited about moving this key issue impacting STEM doctoral students and the Board's vision on developing domestic STEM talent forward.

Phillips concluded the SEP report by saying that the NSBO team would be in touch by email to solicit Board members' comments on the financial barriers one-pager, to take a vote on the innovation thematic report (*Invention, Knowledge Transfer, and Innovation*) and seek approval of the companion piece (*U.S. is a Keystone of Global Science and Engineering*).

Committee on External Engagement Report and Discussion

Ochoa thanked Phillips and the SEP team for their work and turned the floor to Suresh Babu, the new Chair of the Committee on External Engagement (EE) for a report.

The EE met the morning of the Board meeting, December 8, 2021, when committee members reviewed the activities scheduled throughout January for the rollout of the NSB SEP *Indicators* report and discussed potential NSB engagement activities for the next six months and plans for February plenary.

Activities scheduled for January rollout include:

- A virtual briefing for members of the media;
- A private briefing for OSTP and OMB;
- A private briefing for congressional science committee staff which will allow for discussion with the SEP Chair and NCSSES Indicators Program Director;
- A public briefing to the broader S&E community including other congressional committee members and staff, representatives of scientific and higher education groups and federal agencies; and
- Media interviews of board members with Washington D.C.-based media, State and local media outlets.

The larger plan of activities includes additional meetings and briefings with a range of groups that will extend into the summer of 2022, including video clips about *Indicators* reports that will be published on a rolling basis from February through May 2022. Some committee members noted that Board members would need to engage with representatives from scientific societies, higher education associations, universities and federal agencies such as the U.S. Department of Agriculture, National Institutes of Health, and the Department of Energy. Phillips added that a mix of in-person and virtual briefings/interviews would be best.

Near-term Engagement Plans

The overarching goal for congressional meetings is to develop long-term relationships in order to hear firsthand about concerns and priorities, discuss mutual areas of interest including mission priorities such as delivering research benefits, develop STEM talent, and expand the geography of innovation. Babu turned to the engagement plan and asked for feedback on a table of proposed member assignments. Ochoa offered that it would be helpful if the engagement activities in the table were prioritized. Member Scott Stanley asked that his Congressman, Brad Sherman, could be added to the list and whether NSBO staff would coordinate and facilitate the meetings. NSBO staff Nadine Lymn and Reba Bandyopadhyay offered that NSBO staff supporting EE would first contact board members to gauge availability and interest in participating in the proposed engagement activities, then would set up/schedule the meetings, provide preparation materials, meeting demos, and other assistance to facilitate meetings and conversations. Members were also asked to email NSBO EE staff if interested in participating.

Member Aaron Dominquez offered that because many NSB members already have existing relationships with their congressional representatives on issues outside of NSB, the NSBO team could take advantage of those existing networks. Bandyopadhyay and Lymn agreed with this approach and asked members to email them to let them know where and how networks might be leveraged. NSBO EE staff noted they have a spreadsheet whereby they collect network information. Vice Chair Victor McCrary asked if NSBO staff could email the spreadsheet to members as it could help them in their informal, non-NSB meetings to know who knows who. McCrary noted that it is possible that some Board members might be meeting with the same representatives and it would be helpful to know that going into even informal meetings. McCrary noted that although the awards banquet is not for another five months, it would be helpful to have information about Board members networks leading up to the banquet.

Other members stressed the importance of a unified message, bringing along students and entrepreneurs, and ensuring that NSBO EE staff are involved to coordinate and facilitate the activities. Panchanathan reiterated the power of leveraging members' networks and positions as representatives of universities across the country.

NSB February External Panel

Babu turned to NSB member Roger Beachy to give a brief overview of the February panel initiative. Beachy explained that the February panel would serve to inform members and motivate action on Expanding the Geography of Innovation, building on the last two panels and highlighting the elements of regional development and innovation. The committee will ask panelists to speak about what works, such as creating public private partnerships that leverage S&E expertise and interest, rather than what does not work. Beachy would also like to look for

someone that could help catalyze regional workforce development, economic impact and is knowledgeable about creating sustainable enterprises and innovation. Beachy suggested NSB member Dario Gil as a potential host of this panel given his university and industry expertise and connections. Beachy then asked Gil and NSB member Dan Reed, who both have experience in the private sector, for suggestions of panel speakers. NSB member Arthur Bienenstock suggested the author of the book, “Regional Advantage” be considered. Beachy concluded this segment by asking members to send their suggestions to NSBO staff.

Babu concluded the EE report and turned the floor back to Ochoa. Ochoa thanked everyone for making the first day of the Board meeting in the new format go smoothly. She reminded everyone that day 2 would begin at 11:00 a.m. EST. This open session adjourned at 5:35 p.m. EST.

Session 4 (December 9, 11:00 a.m. – 11:45 a.m.)

Committee on Equal Opportunities in Science and Engineering (CEOSE) Biennial Report

Ochoa welcomed everyone back for day 2 of the NSB meeting. She then welcomed the Committee on Equal Opportunities in Science and Engineering also known as CEOSE, a committee that advises NSF on matters relating to opportunities for the participation in and the advancement of women, minorities, and persons with disabilities in education, training, and science and engineering research programs. CEOSE was invited to the meeting to present their biennial report including activities, a review of data on participation, and recommendations for NSF. She noted that this was particularly relevant as closing the gap on the Missing Millions continues to be a major focus for the NSB.

Ochoa turned to NSB member Anneila Sargent to introduce the speakers. Sargent introduced speakers Dr. Jose Fuentes and Dr. Kaye Husbands Fealing, Chair and Vice Chair of CEOSE, respectively. Fuentes is a professor of meteorology at Pennsylvania State University and has been recognized broadly for his efforts in promoting diversity, equity, and inclusion in the Atmospheric and Environmental Sciences. Husbands Fealing is the Dean of the Ivan Allen College of Liberal Arts at the Georgia Institute of Technology. She was the inaugural program director for NSF’s Science of Science Discovery, Communication, and Impact (SoS:DCI) program.

Fuentes began by noting that one of the principles that guides all deliberations within CEOSE is that broadening participation is not a problem to be fixed, but a critical strategy to promote and advance scientific research and learning that will develop a STEM workforce that is representative of all U.S. citizens. He also said that the work on broadening participation is still sometimes misunderstood, undervalued and understudied and that leadership matters. He explained that CEOSE reports provide the state of participation of underrepresented groups in STEM fields, provide a summary of all activities that NSF has supported during the last two

years, a review of NSF policies and practices, and identified opportunities to broaden participation in STEM fields.

Fuentes reported that NSF has pioneered some important programs to broaden participation such as the Established Program to Stimulate Competitive Research program (EPSCoR) and the ADVANCE program, but can still do more to increase knowledge and awareness of invisibility issues in STEM communities. These programs have not reached out to the underrepresented groups that CEOSE would like to reach including African Americans, Hispanic Americans, and Native Americans.

CEOSE's 2019-2020 biennial report recommends that NSF demonstrate and promote bold leadership actions to create, integrate, and make visible elements within and across its programs to enhance participation of underrepresented groups in STEM.

Husbands Fealing presenting some ways that the NSB could support and advance the 2019-2020 CEOSE recommendations to NSF which included helping envision leadership strategies intentionally targeted to underrepresented groups, using an accountability framework and metrics for assessing progress, promoting the development and mentoring of leadership as part of center-wide activities, and supporting pilot programs to develop leadership skills among NSF directorates and volunteer exemplars of strategies in leadership development.

NSB Member Questions

Sargent began by asking whether CEOSE has been able to assess NSF's progress on implementing CEOSE's 2017-2018 recommendations to NSF. Fuentes responded that there has been some progress, for example, in the area of computer science, but in general there is work to do. Husbands Fealing responded that she does not have data or metrics to measure the response to the 2017-2018 report but does have some anecdotal evidence that NSF has engaged in dialogue on how to better structure engagement in research projects.

Panchanathan noted that NSF is committed to implementing CEOSE recommendations. He mentioned that NSF hired the CEOSE co-chair, Alicia Knoedler, to lead the broadening participation portfolio at NSF. He stated that data availability continues to be a challenge and is part of the portfolio that Knoedler leads.

McCrary asked Fuentes and Husbands Fealing if they had any insight from the perspective of employers or politicians as to why broadening participation in STEM is important. Fuentes described interacting with some private sector entities in 2016 or 2017 who expressed an interest in diversity. Husbands Fealing offered some anecdotal evidence of private sector entities pushing for diversity and broadening participation by locating offices and facilities in places where they will have access to diverse populations. She agreed that having quantitative evidence to support the need for diversity is important for policymakers.

Babu asked speakers whether the committee collaborates with trade organizations such as the Manufacturing Association. Knoedler and Fuentes responded that CEOSE sends its reports to a long list of organizations, universities and professional societies for feedback and is pleased with the response it receives.

Fuentes concluded the panel and question and answer segment by thanking NSB members Ochoa, McCrary and Sargent.

NSB *Vision 2030* Implementation Working Group Update

McCrary shared an update on the Board's *Vision 2030* activities since the August NSB meeting. He reminded members that the Board agreed in August to concentrate its activities in the coming year on three *Vision* roadmap areas: Delivering Benefits from Research, Developing STEM Talent for America, and Expanding the Geography of Innovation and to develop a Year 2 Implementation Plan.

McCrary then presented the Year 2 Implementation Plan that had been developed by the Vision Implementation Working Group in consultation with the committees. McCrary explained that the plan was organized by roadmap area. In addition to having two or three items in each of the three aforementioned priority areas, the plan also identifies a handful of activities, such as NSF goals and metrics, that cross all priority areas. Each item on the plan includes the proposed lead committee or subcommittee, the level of additional NSB activity required, and the status of the activity.

McCrary noted several features of the plan, specifically, that it involves all of the NSB committees and subcommittees, has a mix of easy and harder to accomplish items, is sufficiently specific to ensure progress while leaving committees room to execute and adapt to policy and political developments, and reflects the Board's dual role as a governing board for NSF and an advisor to the White House and Congress. Noting that it is important that each NSB committee address one or two *Vision*-related activities well, he emphasized that some activities will be completed in Fiscal Year (FY) 22 while others will lay the groundwork for activities that will extend into FY 23.

In looking at the plan, Stephen Willard raised a question about the division of labor between the Committee on Strategy (CS) and the Committee on Oversight (CO) on goals and metrics. Ochoa responded that she imagined that CS would focus on developing the goals and other forward-looking aspects and that CO would focus on accountability.

McCrary stressed that NSB had been furthering *Vision 2030* implementation, even as VIWG was developing the FY 22 implementation plan. Recent examples of NSB activities included:

- NSB's discussions with NSF on goals and metrics and the Missing Millions
- CS's engagement with NSF on how to further align the NSF 2022-2026 Strategic Plan with *Vision 2030* goals
- The Subcommittee on Technology, Innovation, and Partnerships' engagement with NSF on the new directorate

- The Committee on Science and Engineering Policy’s work on *Vision*-related policy pieces
- CO’s focus on NSF’s diversity, equity, and inclusion work

Before concluding his remarks, McCrary asked that each committee lay out by mid-January a schedule and plan for its *Vision*-related activities for the second quarter of Fiscal Year 2022 (January-March 2022) to assist with overall VIWG project coordination.

Ochoa thanked McCrary, and echoed McCrary’s thanks to the VIWG team, and the committee chairs for developing the FY 22 *Vision* Implementation Plan. The NSB Chair expressed confidence that with ongoing collaboration and coordination that the efforts in the three roadmap areas will be more than the sum of their parts. Ochoa also thanked NSF leadership for its continued engagement as NSB and NSF work together to realize the shared goals of *Vision 2030*, the NSF Director’s three pillars, and the Administration’s priorities.

As there was no further business, Ochoa concluded this portion of the open plenary session at 11:45 a.m.

Session 5 (December 9, 3:00 p.m. – 3:35 p.m.)

NSB Chair’s Remarks

Ochoa reconvened the plenary open session of the 476th meeting of the NSB meeting and welcomed NSF staff, guests, and members of the public. She began by announcing that the Board established the K-12 STEM Education Exploratory Group (KEEG). The group will begin by reviewing the Board’s retreat discussion, exploring the subject through research discussions with NSF, other federal agencies, other actors in the policy space, and will report back in approximately six months with recommendations for next steps for the board and options for goals. Ochoa thanked members who volunteered to establish KEEG, including Matt Malkan as Chair, Julia Phillips, Mel Huff, Suresh Babu, Scott Stanley, and Steve Willard. She also thanked NSBO staff who will support the work of the KEEG, including Faith Hixson and AAAS Science and Technology Policy Fellows Alexandra Surcel and Daniel Elchert. NSB member Malkan thanked Ochoa and said the group would start by developing a KEEG charge.

Ochoa then thanked everyone who was involved in planning and facilitating the board’s October 2021 retreat, including the leader Willard and members Babu, Gil and Phillips. She also thanked NSBO staff members Elise Lipkowitz, Michelle McCrackin, and Ann Bushmiller who supported the effort. Ochoa also thanked NSB members and staff of the Subcommittee on Awards who delivered a slate of nominees for NSB honorary awards. Members included Chair Maureen Condic, and members Babu and Steven Leath as well as NSBO staff Alison Gillespie and Faith Hixson for their support.

Ochoa acknowledged former NSB member Geri Richmond's confirmation as the Undersecretary of Science and Energy at the U.S. Department of Energy. She also acknowledged Alan Stern's selection as a Fellow of the American Geophysical Union.

Ochoa then recognized the new staff in the NSB office, including Andrea Rambow, Executive Secretary and Policy Director, Amanda Vernon, Science and Engineering Policy Analyst, and Daniel Elchert, AAAS Science and Technology Fellow. The Chair also thanked Elise Lipkowitz for work in the role as Acting Executive Secretary after former Executive Secretary Brad Gutierrez retired and her work to prepare Rambow for her new role as Executive Secretary. She also announced that staff member Alison Gillespie accepted a position with the National Oceanic and Atmospheric Administration.

Ochoa recognized two members of NSF's Executive Leadership Team who received Presidential Rank Awards: Wonzie Gardner who received the Meritorious Executive Award and Erwin Gianchandani who received the Distinguished Executive Award. These awardees have been recognized by the President for their exceptional leadership, accomplishments, and service over an extended period of time.

Approval of Prior Minutes

Ochoa presented the minutes of the August 2021 Open Plenary for approval. Those minutes were approved as presented.

NSF Director's Remarks

NSF Director Panchanathan began by welcoming a new cohort of senior executives – Dr. Alicia Knoedler, Office Head, Office of Integrative Activities, Dr. Jennifer Mercer, Section Head, Arctic Sciences, Dr. Joydip Kundu, Deputy Assistant Director of CISE, Dr. Debra Fisher, Division Director, Division Astronomical Sciences, Dr. Anne Johansen, Section Head, Atmosphere Section in the Geoscience Directorate, Dr. Douglas Kowalewski, Section Head for Antarctic Sciences, Dr. John Finamore, Chief Statistician.

Panchanathan also recognized the contributions of Dr. Alan Tessier as he retires from his position with NSF as the Deputy Assistant Director of the Directorate of Biological Sciences.

The Director concluded his remarks by drawing the NSB members' attention to the OLPA report – Office of Legislative and Public Affairs activities report. There were no questions.

Committee on Awards and Facilities Report and Discussion

Ochoa turned the floor over to NSB member Dan Reed, Chair of the Committee on Awards and Facilities (A&F).

Reed began by reporting that the A&F committee met in an open session on December 7, 2021 to hear an update on the Astronomy Decadal Survey report, commonly referred to as ASTRO2020, that was released in November 2021. Major recommendations from the survey include several projects currently in development at NSF. Top priorities are the two Extremely Large Telescopes and two equally ranked second-year priorities, the Cosmic Microwave Background Stage 4 and the next-generation Very Large Array.

Other recommendations include expanding the Mid-scale Research Infrastructure Program and developing long-term plans for sustaining Operations and Maintenance (O&M) funding while projects funded from the Major Research Equipment and Facilities Construction account are in early stages. The report also recommended that NSF increase the budget for individual research grants.

Reed highlighted that ASTRO2020 is also the first decadal to include recommendations for societal workforce impact and workforce development, and for increased transparency for budgets and demographic data associated with awards.

A&F members discussed the report's recommendations and how they intersect with the Board and the Director's priorities, such as addressing the Missing Millions and measuring progress toward goals. Because the report was only recently released, this is the beginning of a conversation between NSF, the Board, and A&F. Reed concluded the report by saying that the Board looks forward to hearing more about NSF's response to the report in the coming months.

Committee on Oversight Report and Discussion

Ochoa turned the floor over to NSB member Anneila Sargent, Chair of the Committee on Oversight (CO).

Sargent began by reporting that CO met on December 6, 2021. The committee laid the groundwork for a busy 2022. CO discussed plans for ongoing engagement with NSF and the CEOSE subcommittee regarding the future of EPSCoR and a meeting in January 2022 with the CEOSE subcommittee co-chairs and NSF senior staff. The committee heard from the Inspector General Allison Lerner on work by the Office of the Inspector General, including a recent settlement agreement which led to a \$1.8 million being returned to NSF. Kearney and Company briefed the committee on results of their most recent audits including NSF's information security program and the financial statement and the DATA Act. NSF received an unmodified opinion for the 24th year in a row and the auditors found no reportable material weaknesses for the 5th year in a row.

NSF's Chief Financial Officer, Teresa Grancorvitz, provided an update to the committee reporting that NSF is currently funding 829 awards, totaling \$250 million, with funds provided by the American Rescue Plan, with additional proposals still being processed. Grancorvitz also provided a timeline of the FY 2021 Annual Performance Plan for context for future discussions. CO members look forward to building on this conversation with the Office of Budget and Finance and Award Management in a closed meeting in January 2022.

CO also considered an updated version of the 2020 Merit Review Digest. Titles and footnotes of two tables of the digest regarding graduate student and postdoc support on NSF grants were revised to clarify that the data in these tables come from proposal requests, not actual student support. The data in the tables has not changed. The committee unanimously recommended that NSB approve the revised Merit Review Digest at this meeting. The committee also voted to recommend that NSB approve the Merit Review Overview. This overview also includes calls for greater accountability for broader impacts data disaggregation and enhanced geographical representation among awardees and contractors. Sargent turned to floor to Ochoa to hold the votes.

Votes: Merit Review Overview and Re-Approval of Merit Review Digest

Ochoa stated that CO referred two items to the board for votes. The first to re-approve the 2020 Merit Review Digest in light of the revisions to titles and footnotes for two charts, clarifying information on graduate student and postdoc support.

Ochoa asked for a motion to accept the 2020 Merit Review Digest. The motion passed and the 2020 Merit Review Digest was accepted as presented.

The second item was the overview to the Digest. The overview celebrated an increase in NSF's funding rate in FY 2020 and also suggested areas of inquiry for additional data collection as NSF and NSB focus on demonstrating accountability in meeting the agency's goals.

Ochoa asked for a motion to accept the Board's overview to the 2020 Merit Review Digest. The motion passed, and the overview to the Merit Review Digest was accepted.

NSB Chair's Closing Remarks

Ochoa concluded the meeting by thanking everyone for their attendance and participation with a special thanks to the guest speakers. She also acknowledged and thanked the NSBO staff and Executive Officer for their willingness to help restructure the meeting to reflect the August pilot. She thanked Committee Chairs for their work to provide robust committee reports during the meeting. She invited members to send her feedback about the meeting.

There being no further business, the meeting was adjourned at 3:31 p.m.

/s/

Andrea Rambow
Executive Secretary to the National Science Board