

**APPROVED MINUTES  
PLENARY OPEN SESSION  
479<sup>TH</sup> MEETING  
NATIONAL SCIENCE BOARD**

National Science Foundation (NSF)  
Via Videoconference  
May 5 – 6, 2022

**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  
Darío Gil  
Melvyn Huff  
Steven Leath  
W. Carl Lineberger  
Matthew Malkan  
Emilio Moran  
Julia Phillips  
Dan Reed  
Anneila Sargent  
Scott Stanley  
S. Alan Stern  
Stephen Willard  
Heather Wilson

**Members Absent:**

Sethuraman Panchanathan, *ex officio*

There being a quorum, the National Science Board (NSB, Board) convened in Open Plenary Session at 10:30 a.m. EDT on Thursday, May 5, 2022, in person and via videoconference with NSB Vice Chair, Victor McCrary, presiding.

## NSB Chair's Opening Remarks

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McCrary welcomed everyone to NSB's 479th meeting. He introduced the meeting as the NSB's first hybrid meeting, explained that due to health and safety reasons, some precautions were put into place such as adding space between seats at the board table, keeping the number of non-board members in the room to a minimum and welcomed the wearing of masks. McCrary thanked NSF Director, NSBO leadership, all staff and Chair Ochoa for their work to stay productive while adapting to changing circumstances. McCrary outlined the agenda for the meeting.

## NSF Director's Remarks

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Panchanathan acknowledged Public Service Recognition week followed by announcements that NSF released its strategic plan for fiscal years (FY) 2022 through 2026 outlining four new strategic goals, that the Biden-Harris administration submitted its budget for FY 2023 to Congress with a request for \$10.5 billion for NSF, and the return to onsite work by many NSF employees as of April 4, 2022.

Panchanathan then shared a video highlighting the importance of NSF's mission and continued investments followed by an announcement that by way of the Alan T. Waterman awards, NSF would recognize three early-career scientists and engineers who demonstrated exceptional individual achievement in research in NSF-supported fields.

Panchanathan turned to the subject of NSF investments by providing a few examples of discoveries with lasting impacts on people around the world. He also highlighted NSF Partnerships for Research and Education and Materials (PREM) award funding for a partnership between the Navajo Technical University and Harvard NSF-funded Materials Research Science and Engineering Center helping students develop a STEM-based solution to contaminated soil and water from more than 500 abandoned mines in New Mexico. The PREM program inspired similar programs across NSF's Directorate of Mathematical and Physical Sciences, the Division of Physics has established the Partnership for Research and Education in Physics (PREP) program, the Division of Chemistry's Partnership for Research and Education in Chemistry (PREC) and the Division of Astronomical Sciences has launched a Partnership in Astronomy and Astrophysics Research and Education programs called PARE.

The Director outlined his activities since the February meeting, aimed at raising awareness of NSF's vision and identifying new partners across the country including NSF's attendance of the South by Southwest festival in Austin, Texas where he announced the launch of the Directorate for Technology, Innovation and Partnerships (TIP). Shortly before this Board meeting, NSF released its first solicitation under the TIP program.

The Director provided highlights of several of his engagements in March and April including meeting with regional stakeholders, students, and faculty and toured research parks in Scranton, Pennsylvania, the University of Rochester in New York, and University of Illinois Urbana-Champaign, some congressional engagements, a roundtable discussion with Chair Ochoa and NSB Committee on Strategy Vice Chair Heather Wilson and other leaders from the University of

Texas system. He also met with the Swedish Ambassador and representatives of the Swedish Foundation for International Collaboration and later in April he joined Dr. Alondra Nelson of the Office of Science Technology and Policy (OSTP) at the American Education Research Association Conference for a discussion on the future of STEM education across the country. Finally, he joined Darío Gil at the IBM Research headquarters in New York for the 2022 Hudson forum where he shared NSF's priorities and NSF's vision for the future of science and technology and testified before the Senate Appropriations Subcommittee on Commerce, Justice, Science and Related Agencies on the fiscal year 2023 budget and importance of continued support for NSF's mission.

### *Cool Science*

NSF staff members Dr. Alicia Knoedler, Office of Integrative Activities, Dr. Sylvia Butterfield, Education and Human Resources, and Dr. Erwin Gianchandani, Directorate of TIP presented examples of NSF-funded research and impacts. Each of the examples were selected to highlight cross-cutting programs from across multiple directorates.

Before concluding his remarks, Panchanathan recognized the achievements of each NSB Member of the 2016 – 2022 class including Arthur Bienenstock, Carl Lineberger, Anneila Sargent, Kent Fuchs, Emilio Moran, Julia Phillips, Victor McCrary and Ellen Ochoa.

## Chair's Activity Summary

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Serving as Acting Chair, McCrary summarized NSB Chair Ellen Ochoa's activities since the February 2022 meeting which included attending a roundtable discussion between leaders of the University of Texas system, NSB and NSF.

McCrary then summarized his activities as NSB Vice Chair since the February 2022 meeting. On March 15th he addressed the Department of Energy's (DOE) National Director Leadership Council on the Board's Vision 2030 and a discussion ensued on developing the missing millions through strategic research partnerships with Historically Black Colleges and Universities (HBCU) and Minority Serving Institutions (MSIs), as the demographics have shifted greatly from regions where these DOE facilities are located and from where they draw their technical workforce. This resulted in a follow-up meeting in April with former Board member Geraldine Richmond on developing new strategies in this area and in alignment with the Board's activities.

On March 23<sup>rd</sup>, McCrary gave a presentation to the Department of Defense (DoD) University Affiliated Research Center Directors, sponsored by the National Academies on the missing millions and new approaches for expanding and creating a diverse, domestic STEM workforce for their ongoing mission requirements. Suggestions included more Independent Research and Development-funded grants to HBCUs/MSIs, and early engagement of middle and high school students on aspiring STEM careers for the DoD and its entities.

On March 29<sup>th</sup>, McCrary participated on a panel with NSF's Gianchandani at the University-Industry Developing Partnerships (UIDP) Mission in Motion conference in Atlanta, Georgia. The Mission in Motion conference was charged to bring HBCUs together with partners like Amazon, and Microsoft.

McCrary concluded his remarks by adding that over the last year, he has given approximately 30 to 40 presentations on NSB's *Vision 2030* and that together with outreach on TIP and the efforts of many others at NSF and NSG, there is momentum.

## Geography of Federal Funding - NSB Panel

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NSB Member Roger Beachy introduced the panel moderator, former NSB Chair and current president at Dakota State University Jose-Marie Griffiths and outlined a few of her accomplishments in the federal science and engineering (S&E) field and in her current position. Griffiths introduced the session by drawing a connection between the NSB's priorities as outlined in *Vision 2030*, the Keystone policy brief, priorities of Congress, the Administration, and NSF to expand S&E capacity across the U.S. and within states. She stated that the goal of the panel presentations and discussion was to bring to light the complexities of an uneven geography of federal research and development funding and to frame the problem in ways beyond simple dichotomies.

Griffiths introduced the four panelists, Marcy Gallo, an analyst in Science and Technology Policy at the Congressional Research Service, Roger Wakimoto, Vice Chancellor for Research and Creative Activities at the University of California, Los Angeles, Cecilia Orphan, Director of Partnerships at the Alliance for Research on regional Colleges and associate professor of higher education at the University of Denver, and Anna Quider, Assistant Vice President of Federal relations for Northern Illinois University.

### *M. Gallo*

Gallo began her presentation by saying that Congress has long been concerned about the distribution of federal S&E funding with some members focusing on ensuring that funding is allocated across the country as a whole and some focusing on its distribution to groups underrepresented in STEM. Using a series of maps, Gallo showed the distribution of federal research and development (R&D) obligations from FYs 2011 through 2019 by state, by performer type (federal scientists and FFRDCs, industry, universities and colleges, non-profits, and state and local governments), and by institution type (RI, high-enrollment Hispanic institutions, R2, MSIs and HBCUs).

### *R. Wakimoto*

The second panelist, Roger Wakimoto presented a map of federal R&D funding by state with the locations of RI universities, public and private, superimposed. He focused on California and proceeded to break down federal R&D funding into different types of institutions including public and private, those that are Association of American Universities, Association of Public and Land Grant Universities and Emerging Research Institutions. He noted that the distribution of funding to private and public institutions across the nation is about a 2:1 ratio which is similar in California.

### *C. Orphan*

The third panelist, Cecilia Orphan, presented her research on how regional public universities (RPU) and Rural Serving Institutions promote equity and community well-being and their role

in closing geographic research deserts. Orphan's presentation featured the characteristics, benefits, funding, and challenges of RPUs. She explained that RPUs grant half of all bachelor's degrees by four-year public institutions and educate 49 percent of students of color attending four-year public institutions. RPUs enroll large shares of first-generation college students, veterans, adults, immigrants, and low-income students, are often their state's most affordable bachelor's degree, draw students from less than 100 miles away and are geographically distributed to ensure local post-secondary access. They contribute millions of dollars each year to local economics and train business leaders, researchers, teachers, public health professionals, and government officials who remain in the region after graduation. Because RPUs maintain accessible admissions practices, they foster greater upward mobility than any other post-secondary sector and also serve their communities by conducting applied research. The Alliance for Researcher on Regional Colleges found that RPUs are particularly important to rural communities and host Small Business Incubation centers, and address employment shortages in those areas. RPUs are diverse and serve the unique needs of their students and communities.

Despite these contributions, RPUs are underfunded relative to other institutional types receiving on average \$9,000 less in public funding per full-time enrollment across the all public funding sources which creates a number of challenges. First, many RIs generate institutional revenue through indirect costs, but RPUs are not able to do so because they often receive fewer and smaller grants therefore RPUs have underdeveloped research infrastructures. Second, RPUs are focused on teaching and often unable to free up faculty time to pursue large grants. Graduate programs are often smaller and in professional fields, which means fewer graduate students to support research. Third, federal grants often entail complicated applications, which are difficult for RPUs to complete given staff shortages due to funding inequities and limited faculty time.

Barriers to pursuing federal R&D funding could be reduced with planning and development grants which would allow RPUs to develop research infrastructures, federal agency staff could support RPUs in applying for grants, and federal grants can be tailored to the regional service missions of RPUs. There is an enormous untapped potential among RPUs. They are immersed in their communities and have regional partnerships that can be better leveraged to produce R&D, but is currently difficult to realize. RPUs are positioned to develop diverse STEM talent, train STEM K-12 teachers and conduct applied research to improve K-12 curricula, and they exist to serve their regions which would contribute to the expansion of the geography of innovation through partnerships with regional industries, government agencies, and nonprofit organizations.

#### *A. Quider*

The fourth and final panelist, Anna Quider, spoke about emerging research institutions (ERI) and MSIs and the vital role they play in the U.S. Two key components of an ERI that are it must have an upper limit in the range of \$35 to \$50 million in annual federal research expenditures, and must enroll undergraduate students. ERIs are in every state. Quider then presented an analysis of the 637 institutions that reported federal S&E research expenditures in FY 2018 helpful for understanding whether federal research investments are reaching a broad cross-section of institutions spanning the U.S. This analysis showed that 139 institutions received 90 percent of federal research funding and nearly 500 ERIs collectively received only 10 percent. Despite receiving nearly all of the nation's research funding that went to higher education institutions, these top research institutions enroll less than half of all students. And only about one-third of

underrepresented minority students who attend one of these 637 research-active institutions. The data show that ERIs enroll proportionally more underrepresented minority students compared to the top research institutions. Nearly identical trends play out for Federal Pell Grant recipients who are the nation's most financially disadvantaged students. The analysis also showed that two-thirds of the nation's underrepresented minority students or Pell Grant recipients attend research-active institutions that see only about 10 percent of federal research dollars on their campuses and therefore fewer campus-based research opportunities for students, many of whom cannot leave their community to pursue research opportunities. The concentration of federal research support in a small number of the nation's higher education institutions presents a structural impediment to geographic diversification of the STEM talent pipeline.

She explained that an MSI designation refers to higher education institutions that meet the eligibility criteria for a suite of programs at the U.S. Department of Education. Over the decades, new categories of MSIs were created to direct resources to institutions serving specific types of minority students who attend low-cost institutions with high enrollment or financially needy students. Quider explained that there are minimum enrollment thresholds for various race ethnicities, which correspond to MSI programs. For example, eligibility for the HSI program requires a minimum undergraduate enrollment of 25 percent Hispanic students, and for the predominately black institution program requires a minimum undergraduate enrollment of 40 percent black students. The most recent student enrollment data show that there are institutions where over 50 percent of undergraduates are students of color, yet they are not MSI eligible. This includes 199 institutions that do not meet the minimum race ethnicity enrollment thresholds and 159 institutions that meet the race and ethnicity thresholds but do not meet the cost or need student criteria. Most of these excluded institutions are ERIs. The Department of Education offers a waiver program for institutions that do not meet the needy student criteria or the cost of attendance criteria, but there is no process for securing a waiver for an institution that serves a high percentage of students of color yet does not meet the minimum threshold of enrollment for a specific race or ethnicity group. A number of current or proposed programs by the NSF and other federal agencies seek to expand race ethnicity diversity in STEM gives preference to or are only open to federally designed MSIs, yet the MSI designation is not capturing the full spectrum of institutions that serve a high percentage of students of color.

#### *Question and Answer*

NSB members and panelists engaged in a question and answer session. Melvin Huff asked if there was data indicating the distribution of federal funding across STEM fields and Gallo responded that NSF has that data, but not broken down by state. Babu asked how funding to federally-funded research and development centers (FFRDCs) gets distributed to universities and whether there is data showing the role that FFRDCs play in working with the HBCUs and MSIs. As a former Director of a FFRDC, Wakimoto responded that data are available through a university consortium that provides statistics on how money is distributed and serves the university community. Daniel Reed provided some background on a federal project, STAR METRICS, which was established to try to determine what an industrialized country should invest in advanced research and development. The project failed. Then the Big 10 started a project to pool all of their research expenditure data allowing them to see where the money was spent, not only where it was awarded. That project is now the nonprofit called IRIS (Institute

for Research Innovation and Science). He explained that IRIS data are incomplete because there are few member institutions, but show direct expenditures and collateral effects such as the number of job created as a result of the investment in basic research.

Suresh Garimella asked whether there is a correlation between the geography of federal funding and geography of innovation and which should come first. Wakimoto responded that based on his experience in California there is a strong correlation and funding must come first. Quider added that there is a lot of capacity for innovation everywhere but opportunities to realize the potential are more limited. Orphan agreed that RPUs know very well their areas of strength and potential innovation but because of the funding disparities innovation is difficult to realize.

McCrary asked whether it was possible to map where innovation and talent are, demonstrated by outputs such as patents, technology commercialization, and intellectual property disclosures, and lack of access. Gallo thought that NCSES could probably perform that type of analysis and Quider added that there have been some recent efforts to understand how federal funding is translated into things like patents and job creation for example.

Beachy asked whether the panelists could comment on how federal agencies could play a role in supporting RPUs and other emerging institutions. Panelists offered that federal agencies including NSF could offer planning or developmental grants to assist with the effort to apply for federal funding and incentivizing RIs to partner with ERIs and RPUs to share research infrastructure. Quider cautioned that the incentives to partner would have to be carefully designed to ensure meaningful partnerships with commitments to faculty exchanges to build capacity at ERIs, for student research opportunities or to build the capacity for grants administration, for example. Another area where NSF could assist is facilitating connections between institutions such as UCLA and Northern Illinois University or Dakota State for example. Developing a mechanism whereby institutions can learn about other institutions and their capacities to encourage not just horizontal mixing of like-institutions, but vertical mixing among Carnegie classes of institutions would be helpful.

Artie Bienenstock outlined what is needed to support a research enterprise at a university, including a relatively low teaching load, an office of sponsored contracts to manage contracts effectively, and an effective purchasing and receiving system. Lower funded institutions tend to have higher teaching loads and less infrastructure, including that which is needed to apply for and administer federal funding. Federal funding does not cover the cost of administering grants. Those institutions receiving most of the federal funding for R&D also receive good state support or have high endowments and gifts to cover the cost of administering the grants, resulting in a concentration of federal funding. The federal government needs the states to join the effort to distribute funding more equitably. Orphan agreed with Bienenstock's observation and described a federal-state partnership test case in Texas where the state has devoted resources in combination with federal R&D funding to help support the creation of a research infrastructure in RPUs across Texas. There has also been some movement by RPUs to mimic more of what an RI research or professor's teaching load looks like and adding staff to support grants and sponsored research. She agreed that NSF has a role to play but that it cannot fix all of this.

Bienenstock added that he supports increasing Pell Grants to 70 to 90 percent of the cost of attending college.

Panchanathan contributed to the discussion on how innovation occurs, where it exists and how it is supported or funded, including the K-12 and community college systems and through investments by the federal government, including Pell Grants, and state governments. He described the new NSF program GRANTED (Growing Research Access for Nationally Transformative Equity and Diversity) as one that will provide a virtual research office for proposal development, pre-award, and post-award support for institutions and individuals. NSF requested \$50 million for the GRANTED program in the fiscal year 2023 budget request. GRANTED and other NSF programs and mechanisms encourage partnerships between R1, R2 and MSIs for example. Panchanathan added that the TIP Broad Agency Announcement recently released encourages equity for R1 and ERIs.

### **Session 2 (May 5, 12:55 p.m. – 1:30 p.m.)**

## Q&A with the 2022 NSF Waterman and NSB Public Service Awardees

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NSB's Honorary Awards Committee Chair Maureen Condic introduced NSF's three Alan T. Waterman award winners, Daniel Larremore from the University of Colorado, Boulder, Lara Tompson from the University of the District of Columbia, and Jessica Tierney from the University of Arizona. She also introduced the two NSB's Public Service Award winners, one individual award to Betty Lise Anderson from the Ohio State University and one organizational award to the National Organization for Professional Advancement of Black Chemist and Chemical Engineers (NOBCCheE) accepted by Rena Robinson from Vanderbilt University. Each award winner presented a brief personal background and their work followed by a question and answer session with Board Members.

### **Session 3 (May 5, 2:40 p.m. – 4:45 p.m.)**

## Richard W. Spinrad, PhD, Undersecretary of Commerce for Oceans and Atmosphere and NOAA Administrator

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McCrary began the next session, a presentation and discussion with Dr. Rick Spinrad Undersecretary of Commerce for Oceans and Atmospheric and NOAA Administrator. The aim of the session was to gain an understanding of NOAA's current priorities and collaborations between NSF and NOAA, NOAA's strategies and approaches to broadening participation and advancing diversity, equity, inclusion, and accessibility within its workforce, and how to work together to nurture talent through science and the engineering ecosystem. Panchanathan followed with a more detailed introduction of Dr. Spinrad's current and past positions, a description of the relationship between NOAA and NSF and priorities in common (see "relationship with NSF" below).

*NOAA's strategic priorities*

NOAA's strategic priorities are earth system science, earth system stewardship, and earth system service. Dr. Spinrad explained that there is an equity element to what NOAA is doing that will fundamentally reorient a lot of NOAA's work, by providing products and services more equitably and co-developing those products and services. For example, NOAA has been conducting climate and equity round tables around the country, focused on issues such as drought in the Southwest and flooding in the Mississippi River Basin. Using these issues, NOAA identifies where products and services need to be developed more aggressively. Dr. Spinrad is also interested in building a stronger culture of innovation at NOAA and changing its risk tolerance in terms of what NOAA is willing to invest in to translate to the operational domain. Other climate priorities include mitigation, decarbonizing and renewable energy as well as strategies for nature-based adaptation and resilience. NOAA received about \$3 billion in the infrastructure bill for the next five years, a large portion of which is tied to coastal resiliency. NOAA is in an unusual position because it received an extraordinary budget increase of 17% over its FY 2022 allotment.

#### *NOAA – Internal Efforts*

Along the lines of co-developing, NOAA hired a tribal engagement specialist who is a PhD in Fisheries Biology into its senior team. NOAA wants to start dialogues early, especially with tribal entities, to ensure that the agency benefits from indigenous knowledge and develops the products most needed. NOAA is also working internally to improve diversity, equity, inclusion in NOAA's workforce. NOAA is working to identify ways to use existing programs in the academic community to accelerate bringing young people from diverse backgrounds into the workforce. Dr. Spinrad described his political team at NOAA as 80% female, of which 50% are people of color.

#### *NOAA – External Efforts and Priorities*

Dr. Spinrad is encouraging a robust and aggressive economic development agenda and plans to leverage sister agencies within the Department of Commerce such as the Economic Development Administration, Patent and Trademark Office, and National Institute of Standards and Technology (NIST). NOAA's priorities include further development of the New Blue Economy, exploring needs for products and services that support economic development and establishing NOAA as the federal authoritative source for operational climate products and services in support of a range of missions. NOAA estimates that the climate services sector is potentially a \$100 billion industry. The demand for NOAA's information, products, and services is increasing and the agency is working to get into position to work with partners and interagency groups associated with hazards such as climate, drought, fire, flood, and hurricane.

#### *Partnerships*

NOAA is building partnerships in the area of the emerging climate services sector and the academic community. For example, NOAA's first cooperative institute through the National Weather Service is with the National Water Center at the University of Alabama. NOAA is also building relationships with non-traditional partners such as the National Association of Realtors or the American Medical Association who are recognizing that they have a need for climate products and services.

### *Relationship with NSF*

NOAA and NSF entered into a Memorandum of Understanding (MOU) in February 2022 which will allow the agencies to coordinate on the development and support of research activities and facilities. Common near-term priorities are climate science with a focus on accelerating the transition from research outcomes to operations – ensuring that the research process and decisions play a role in decision making – and from operations back to research – ensuring that operational needs are built into research agendas. Dr. Spinrad and the NSF Director meet quarterly on these and other shared priorities, including STEM education pathways, collaboration with NSF AI (Artificial Intelligence) Institutes, and building a better understanding of how to increase resilience in response to increasing wildfire, drought, flooding, extreme heat, and coastal weather-based events. NOAA is interested in working with NSF in the growth of NOAA missions, for example in the area of commercial space. NOAA has a science advisory board and there could be opportunities for NSB and NOAA’s Science Advisory Board to collaborate.

### *Questions and Answers*

McCrary began by noting that many research universities are concentrated on the nation’s coasts and asked whether NOAA had any best practices for connecting people who live in other parts of the country. Dr. Spinrad explained that NOAA’s mission priorities are grounded in requirements and not geography. NOAA has 620 facilities around the country and invests broadly across the U.S. Alan Stern asked how NSB can help NSF advance the collaboration between NSF and NOAA. Dr. Spinrad offered that NSB and the NOAA’s science advisory board identify some key common issues and engage in a strategic dialogue. He suggested exploring how the agencies make the transition from research to operations, applications, commercialization, and utilization, how to ensure that the research and technological developments coming out of NSF are available to NOAA, and how NOAA can help NSB identify strategic priorities for research investments. Scott Stanley was interested in understanding what NOAA is looking for from firms in the commercial space industry. Dr. Spinrad explained that the two companies NOAA is starting to work with own the access to some data streams coming from satellites. These companies are beginning to recognize the capability of using that data for different of applications. NOAA is exploring how to build products and services to ensure the capability is quality controlled and that data are going to be there.

Julia Phillips asked about NOAA’s support for long-term geodetic capabilities in support of various aspects of climate change, symptoms such as sea level rise and atmospheric probing, and what NOAA and NSF might be able to do in that area. NOAA’s current operational activities are in “pretty good shape”, but Dr. Spinrad expressed concerns about workforce development and the ability of NOAA to gather the abundance of high-resolution data needed. NOAA is currently relying on aircraft-based operational systems and NOAA but has very few aircraft. Phillips called Dr. Spinrad’s attention to a proposal for a workshop on the topic of geodesy through the academies.

Suresh Garimella stated that he hopes that the NSF Director and Dr. Spinrad working together will serve as a partnership model that produces better outcomes. Dr. Spinrad agreed and provided more examples of efforts to develop partnerships with NASA, USGS, DOE, and DoD/Navy. Dr.

Spinrad would like to see a continued dialogue around how the federal government invests in research at OSTP.

Suresh Babu asked how NSF and NOAA could collaborate on STEM education in connection with climate. Dr. Spinrad sees a need for fresh thinking and would like to establish a formal youth engagement position, someone possibly under the age of 25 with the role to tap into the intellect of that age group and the passion for the issues.

## Committee on Strategy Report

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Committee Chair Suresh Garimella reported that on April 29, 2022, the Committee received an update from Director Panchanathan, Chief Operating Officer Karen Marrongelle and Budget Division Director Carolyn Fife on NSF's FY23 budget request submitted to Congress in March 2022. The NSF team presented the proposed allocations for different directorates and appropriations for TIP and the consolidation of funding for the Graduate Research Fellowship program from the Office of Integrative Activities (OIA) into the Education and Human Resources Directorate (EHR). The team informed the Committee that in order to capture the work more accurately, the names of two directorates will likely be changed; EHR may be changed to the Directorate for STEM Education or EDU and within EDU, Human Resources Development may be renamed the Division of Equity for Excellence in STEM. The Director briefed the Committee on multiple congressional meetings on NSF's budget request and noted strong congressional support for TIP and interest in the new NSF GRANTED program. The Director also testified before the Senate Appropriations Committee and is scheduled to testify next week before the House Appropriations Committee where he will talk about TIP and how it can contribute to unleashing innovation, climate, and clean energy and technologies for the future. Garimella concluded his report by stating the Committee plans to meet with NSF in late May or early June to discuss Board engagement in NSF's budget and performance management process.

## Committee on Oversight Report

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Committee Chair Anneila Sargent reported that the Committee on Oversight (CO) met on April 4, 2022, where the Committee received a presentation by Alicia Knoedler, Head of OIA regarding NSF's approach to broader impacts of the science and engineering funded by NSF. The Committee met again on April 28, 2022 where members received the results of a review conducted by the Office of Inspector General on plagiarism connected to NSF-funded research, including causes and recommendations to prevent it. Members also received a report from NSF's Chief Financial Officer and Performance Officer Theresa Grancorvitz who reported that NSF is continuing with its outreach plan to provide interested researchers with information on the grants process and is on track to award all funds provided under the American Rescue Plan by the expiration date of September 20, 2022.

Sargent devoted some time to summarizing the Committee's work and accomplishments over the last two years. Highlights included modernization and accessibility improvements to the Merit Review Digest, development of a Board-approved overview for the digest, Board approval of two resolutions on training to improve merit review and on adding broader impacts (BI) experts, engaged with the larger BI community, and developed a new relationship with the Committee on

Equal Opportunities in Science and Engineering (CEOSE). More recently, the Committee has begun to turn its attention to the issue of geography of innovation and the Established Program to Stimulate Competitive Research (EPSCoR). Sargent concluded her report by noting that it has been 11 years since the Board examined NSF's Merit Review Criteria and recommended that CO do so in light of NSB's Vision 2030 and the many changes in the scientific enterprise over that time. Most importantly, NSB might consider whether the criteria are still optimal for ensuring the Foundation's ability to achieve its scientific and societal goals.

## Committee on External Engagement Report

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Committee Chair Suresh Babu summarized the work of the Committee on External Engagement (EE) since NSB's February meeting. The Committee met on April 28, 2022 to discuss survey results of NSB Members on potential revisions to NSB's honorary awards goals, criteria and process and considered recommendations to revise the honorary awards to be presented at the May Board meeting. Finally, Committee members also discussed upcoming engagement activities and priorities for the next iteration of the EE including continuing the series of external panels.

Babu turned the floor to Committee Chair of the Ad Hoc Committee on Honorary Awards Maureen Condic who reminded members that in December 2021, EE was tasked with evaluating the NSB's two honorary awards, the Vannever Bush Award and the Public Service Award, and bringing recommendations to the Board meeting in May 2022 to strengthen and diversify the nomination pools. About half of NSB members responded to the survey and recommendations drafted by EE were included in the May board book. Condic presented recommendation highlights, including clarifying that the goal of each award is to recognize public service, specifically to better reflect the goals of the Board's Vision 2030, TIP and the congressional priority of delivering benefits to society, retaining the Vannever Bush Award as a career capstone award, and simplifying the nomination and review process. Before opening the subject up for discussion, Condic offered adding a prescreening process, consisting of one paragraph that the Board would review before requiring nominees to dive into a more complicated and lengthy nomination process. With that, Condic invited discussion about the recommendations.

Board members Dan Reed and Suresh Garimella agreed with simplifying the process and retaining the VBA as a career capstone award. McCrary asked whether EE got any insight into where best to market the awards to get a more diverse set of nominees and how best to use social media to disseminate information about the awards to which Condic stated that these topics were discussed at length during the Committee meeting. She also noted that perhaps the Board should consider adding a monetary reward as incentive in the amount of \$10,000 for example. Garimella and Phillips did not agree that a monetary reward would necessarily serve as an incentive for several reasons including people nominating others or self-nominating are often very senior for which money may not be a motivator, but rather for whom lack of time is an issue, the people nominating others would not be the ones receiving the reward, and perhaps some uncertainty about whether the accomplishments rise to the level of the VBA.

Members offered several other ideas including engaging and brainstorming with the National Academies Presidents and Board members with wide networks, getting some support for the

effort, possibly through the NSB Office, engaging in some post-award activities such as publicizing the results and impact of the awards to both demonstrate the link to Vision 2030 and get the word out about the awards, and helping research institutions identify VBA awardees to speak at commencement ceremonies which could result in inspiration for young scientists could all be helpful. Aaron Dominquez asked whether there was a process to remove someone's award if they proved themselves unworthy of the award in the future. John Veysey added that the question was raised a couple of years ago and the conclusion was not to adopt a formal process.

## Committee on Science and Engineering Policy Report

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Committee Chair Phillips reported that the Committee on Science and Engineering (SEP) met in open session on April 25<sup>th</sup>. Members discussed the culmination of the Indicators 2022 cycle, lessons learned and opportunities for improvements as the committee prepares for the 2024 cycle and reviewed a retrospective of the policy products produced by the committee over the last two years. Some highlights of committee work since February 2022 included wrapping up the 2022 Indicators cycle, reviewing and releasing the remaining thematic reports and conducting briefings at NIST, the Department of Energy, the National Academies' Space Week, and the Division of Engineering and Physical Sciences Committee. In April, Committee Vice Chair Condic served as a panelist for an informational webinar with 200 attendees from around the country, cohosted by the Board and NCSSES, on state indicators spotlighting the availability of tools and resources around state level data. Phillips noted the Board is reaching new audiences by way of virtual briefings and plans to add virtual briefings to Indicators rollouts in future cycles. Phillips announced the official end of the 2022 Indicators cycle and acknowledged the hard work of all involved. She also announced that the 2024 Indicators cycle had just begun.

### *“International STEM Talent for a Robust US. Economy”*

Phillips then turned to the subject of the policy one-pager on the economic impact of and the critical role international students and workers play in the U.S. STEM enterprise. Phillips noted that the one-pager was approved by the SEP committee and was included in the May Board book for NSB Members' consideration. Phillips summarized the issues and recommendations outlined in the one-pager and invited questions and comments. Beachy asked if there had been any contrary response or comments to the recommendations in the one-pager and Phillips responded that there had been none. Receiving no additional questions or comments, the Board voted and approved unanimously for publication the policy one-pager entitled “International STEM Talent for a Robust US. Economy”.

### *Socio-economic Status*

Phillips then turned to the Socio-economic Status (SES) working group, led by Condic and Reed and includes members Phillips, Babu, Artie Bienenstock and Steve Willard. Phillips reminded Members that the working group began with a call for volunteers to lead an exploratory effort to consider the topic further. The idea emerged from the Board's work on Indicators, the work done on the keystone document and by the Board's Nurturing Talent policy team to address financial barriers for post-secondary students in STEM and a broader call to address issues related to socio-economic status directly.

Condic summarized the working group's accomplishments since February which started with considering different measures of socio-economic status and barriers to success in STEM, then engaging NCSES to assist with identifying the best data to measure the outcome associated with the measure the working group adopts. The working group decided to focus on graduate students because that is where it would have the greatest influence. The group has begun to brainstorm and outline potential policy pieces in line with NSB's Vision 2030. Reed added that the group worked to organize the discussion into things that NSF can do, how it allocates funds or graduate fellowships for example, and things that the Board can advocate that the National Science and Engineering enterprise should do. Willard emphasized that the working group has taken a data-driven approach to this subject.

Phillips concluded the SEP report by saying that what was particularly rewarding about working on SEP this cycle was the number of policy issues that the Board managed to do something about. She added that the work of SEP helped spark the Explorations in STEM K-12 Education or ESKE working group.

## Explorations in STEM K-12 Education Working Group

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Explorations in STEM K-12 Education (ESKE) working group lead Matthew Malkan introduced the members of the group and gave a brief summary of the origins of ESKE during the Board's 2021 retreat then summarized ESKE's activities since February. ESKE has continued listening sessions with stakeholders and has begun to focus on three areas. First, ESKE is interested in learning more about what NSF and the Board can do to address the deficiencies and gaps in STEM education beginning in elementary school which widen by the time students reach high school and college. Second, ESKE will focus on the acute STEM teacher shortage and related issues including the distribution of STEM teachers and the overreliance on substitute teachers. ESKE is planning on looking closely at the current certification process and exploring how institutions such as community colleges might play a larger role in teacher education, such as offering a two-year associates degree in a STEM field to help prepare STEM teachers for elementary school. Third, understanding how to get research and knowledge to teachers in classrooms. A challenge related to this issue is the lack of longitudinal data that would allow NSF to follow a student from elementary school through college. Malkan announced that ESKE would be hosting two full days of listening sessions in June where members will hear from stakeholders representing the National Science Teachers Association, experts on STEM standards, and K-12 experts at the Department of Education, among others. Malkan welcomed thoughts and comments of Board members.

McCrary recommended conducting a retrospective study across different types of schools and different types of students, such as international and domestic students. The advantage of a retrospective study is that one would not have to wait 10 or 12 years to get data. Gill mentioned Math for America, an organization started by Jim Simons about 20 years ago in New York City aimed at providing supplemental funds to the best teachers. Simons eventually scaled that up to include all of New York state and there is active dialogue to scale up the program nationally. Gil suggested that the Board could meet with Simons to discuss how NSB could help accelerate the program. Emilio Moran suggested contacting NSF's Social, Behavioral and Economic (SBE) Sciences directorate to learn more about a study that follows families over time and might

include information on education. Beachy suggested that learning about the policies that affect state and local education and speaking with the heads of education from states performing well and those not performing well might be helpful. He raised the issue of New Mexico being one of the lowest performing states in education and a recent pay raise for teachers in the state. Condit agreed that raising teachers' salaries is a good idea in general, but questioned whether there was a correlation to students advancing into STEM degrees. She asked members to think critically about how to get actual data on what works and does not work.

NSF's Karen Marongelle, Assistant Director for EHR and Chief Operating Officer, offered that teacher pay, stress and workload puts additional pressure on the teacher shortage. In terms of data, the SBE directorate has good data to help understand the impact of virtual learning on student and families with additional helpful data available from NSF partners at the Department of Education. A persistent statistic is that 20 percent of all students of different demographics entering universities declare a major in STEM disciplines. Is that something the Board wants to increase? How do we do that working in concert with our colleagues in K-12? And what should we do within institutions to encourage students to continue in STEM? We need partnerships with local school districts, school boards and state departments of education.

Reed rounded out the discussion by adding that the Board needs to be data driven, but to achieve change, it has to be politically executable. Otherwise, it is just information that is useful to know, but it does not actually affect the change desired.

## **Session 4 (May 6, 10:30 a.m. – 11:00 a.m.)**

### NSB Chair's Welcome and Remarks

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Ochoa began her remarks by outlining the agenda for the day then provided an NSBO staff update including retirement of Bruce Levenson, welcomed new staff member Jasmine Perry and congratulated Reba Bandyopadhyay on her opportunity for a detail with the White House Office of Science and Technology Policy.

### Approval of Prior Minutes

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Ochoa presented the minutes of the February 2022 Open Plenary for approval. Those minutes were approved as presented.

### NSF Director's Remarks

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Panchanathan began by recognizing the five awardees, three Alan T. Waterman awardees and two NSB Public Service Awardees.

Panchanathan then pivoted to welcoming a new cohort of senior executives since February 2022 including Graciela Narcho, Deputy Assistant Director, TIP directorate; Dr. Simon Malcomber, Deputy Assistant Director in the Directorate of Biological Sciences; Lisa Scott, Deputy Division Director, Division of Grants and Agreements; Dr. Ray Fouche, Division Director in the Division

of Social and Economic Sciences of the Directorate of Social, Behavioral and Economic Sciences; Dr. Alan Liu, Geospace Section Head for the Division of Atmospheric and Geospace Sciences in the Directorate of the Geosciences; Dr. Amy Walton, Deputy Office Director in the Office of Advanced Cyberinfrastructure within the Directorate for Computer and Information Sciences and Engineering; Dr. Stephen Mackwell, Disciplinary Program Section Head, Division of Earth Sciences within the Geoscience Directorate. The Director concluded his remarks by drawing NSB members' attention to the activities report of the Office of Legislative and Public Affairs.

## **Session 5 (May 6, 1:30 p.m. – 2:30 p.m.)**

### Vision Retrospective

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Ochoa began the final open session of the NSB meeting and announced the results of the NSB elections. The NSB Chair elect is Daniel Reed and the Vice Chair elect is Victor McCrary.

Ochoa reflecting on her role as Chair, the launch of the Board's Vision 2030, the coordination demonstrated by Panchanathan and his leadership team to incorporate Vision 2030 priorities into the Foundation's overall vision. She thanked McCrary and members of the Vision Implementation Working Group (VIWG) and all Committee leadership for moving the Board forward to implement the vision in a coordinated way. She concluded her remarks by thanking Board members for their support and feedback in connection with holding committees meetings separate from Board meetings which she believes will allow Committees to enhance the ability to focus not only on routine items, but on activities associated with division priorities and not be constrained to fit in with the allotted time within Board meetings.

McCrary then presented a retrospective of the Board Vision 2030. McCrary presented highlights of the Board's vision related work and accomplishments since May 2020. Some of the highlights have included disseminating the Board's vision and expertise on related subjects through a series of external panels at Board meetings and socializing important terms such as missing millions and geography of innovation with policymakers, educators, advocates and the NSF via engagements with federal and state leaders, academic, business, scientific and educational organizations.

Some of the accomplishments achieved through coordinated efforts by the Board and NSF have included NSF's prioritization of its America Rescue Plan funds to support individuals and institutions most strongly affected by the pandemic, development of NSF's 2022-2026 strategic plan that focuses on development of STEM talent, especially those underrepresented in the S&E enterprise, and NSF's fiscal year 2023 budget request which increases the investment to existing programs such as INCLUDES and proposes investments in new programs such as GRANTED. The Board also published several policy pieces during this Board cycle on talent including the resilience of STEM jobs to economic downturns, the state of K-12 STEM education in the U.S. and financial barriers to building diverse STEM workforce. Most recently, NSB formed a working group to explore what can be done to improve K-12 STEM educational outcomes in the U.S. and how NSB might contribute to advancing this policy. Most recently, the Board has embarked on a holistic exploration of the geography of innovation, starting with NSB's external

panel series and began working with NSF to identify higher-level, longer-term goals and indicators of progress.

McCrary noted that results still need to come, but that the ideas in Vision 2030 are gaining traction visible in the Director’s vision and legislative language. McCrary thanked Board members, NSBO staff and NSF leadership and staff for their contribution to the development and implementation of Vision 2030.

## NSB Chair’s Farewell to Members

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Ochoa and Director Panchanathan delivered thanks to all Board members, then recognized each individual member of the 2022 class with parting words and a token of appreciation. The class of 2022 included Artie Bienenstock, Kent Fuchs, Carl Lineberger, Emilio Moran, Julia Philips, Anneila Sargent, and Victor McCrary.

There being no further business, the meeting was adjourned at 2:55 p.m.

8/4/2022

**X** Andrea Rambow

Andrea Rambow

Signed by: ANDREA I RAMBOW

Andrea Rambow  
Executive Secretary to the National Science Board