

**Meeting of the Directorate for Education and Human Resources (EHR)
Advisory Committee**

Thursday, May 31, 2018 and Friday, June 1, 2018
National Science Foundation, Room 2020
2415 Eisenhower Avenue, Alexandria, VA 22314

Advisory Committee (AC) members present: Bruce Alberts, Hyman Bass, Elizabeth Boylan, Cathy Casserly, Carlos Castillo-Chavez, Muhammed Chaudhry, Rory A. Cooper (virtual), Margaret Honey, Okhee Lee, David H. Monk, Roy Pea, Debra Joy Pérez, Francisco C. Rodriguez (chair), James Spillane, Marilyn Strutchens, Laurel Vermillion, Lilian Wu

AC members absent: John T. Bruer, Sian Beilock

DAY 1: Thursday, May 31, 2018

8:30 – 9:00 Welcome

Dr. Francisco Rodriguez, Chancellor, Los Angeles Community College District;
Chair, EHR AC
Dr. Jim Lewis, Acting Assistant Director, EHR

Dr. Rodriguez opened the meeting by welcoming the AC members and reviewing EHR's three pillars: STEM learning and learning environments, broadening participation and institutional capacity, and STEM workforce development. He discussed how the pillars relate to today's three EHR AC subcommittees on The Future of STEM Education, Broadening Participation, and Public-Private Partnerships.

Dr. Lewis welcomed AC members and reviewed staffing transitions in the EHR Office of the Assistant Director (OAD). He recognized previous AC coordinator and AAAS Policy Fellow Dr. Timna Wyckoff, now Assistant Director of the Institute for Bioscience & Biotechnology Research, a partnership between University of Maryland and NIST (National Institute for Standards and Technology). He also recognized Dr. Tori Smith and Dr. Sarah-Kay McDonald who have joined the OAD as Science Analyst and Senior Advisor, respectively. After presenting a number of EHR program and project accomplishments, he noted that Dr. Joan Ferrini-Mundy will leave NSF to begin as President of the University of Maine and the University of Maine Machias on July 1, 2018, and Dr. Dean Evasius will leave on June 30, 2018, to become an Associate Vice President for Research at the University of Virginia.

Next, Dr. Lewis presented an overview of the EHR budget, discussed the NSF policy on sexual harassment, and provided updates on HSI conferences, the National Academies' Graduate STEM Education for the 21st Century report, AC subcommittees, and the open searches for a Division Director in the EHR Division of Graduate Education and the EHR Assistant Director.

9:00 – 10:30 Panel 1: Current Challenges for the Future of STEM Education (“Reports on Reports”)

Moderator: Dr. Sarah-Kay McDonald, Senior Advisor, EHR

- *The Future of Undergraduate Education*, American Academy of Arts & Sciences (AAA&S), 2017. Presented by Dr. Francesca Purcell, Program Director, Education and the Development of Knowledge, AAA&S
- *Data Science for Undergraduates: Opportunities and Options*, National Academies of Sciences, Engineering, and Medicine (NASEM), 2018. Presented by Dr. Nicholas Horton, NASEM Committee Member and Professor of Statistics, Amherst College
- *Graduate STEM Education for the 21st Century*, NASEM, 2018. Presented by Dr. Thomas Rudin, Director, Board on Higher Education and Workforce, NASEM

Dr. Purcell focused her presentation on points of concern and important facts regarding the future of undergraduate education. These include: unequal college attainment rates for different gender and racial/ethnic groups; academic under-preparedness (half of college students enroll in remedial courses); the number and amounts of student loans; high default rates on loans to students who do not complete their undergraduate education; and socioeconomic differences in on-time graduation rates. Most students (more than 85%) enroll in post-secondary education within eight years of high school graduation, but only 1% of all students attend highly selective colleges while most students (76%) attend public schools. Adult and part-time learners make up a significant portion of all students (30%), and there is a 50-50 split between students pursuing Bachelor’s degrees and students pursuing Associate’s degrees and certificates. Dr. Purcell noted that “college is worth it”, and that solid, rigorous curricula, supportive environments, and evidence-based teaching practices contribute greatly to a quality education. She expects the future to include widespread adoption of evidence-based teaching practices and development of guidelines to measure effective teaching practices.

Dr. Horton highlighted the increasing dependence of society on data and the need for new college graduates to be able to analyze data effectively. He provided a link to the *Data Science for Undergraduates: Opportunities and Options* report and webinar recordings that present the report’s finding and recommendations, and other related topics. He also highlighted the report’s findings and recommendations, including the key concepts that are needed to develop a data acumen in future data scientists and the variety in programs that is likely to emerge in order to prepare different types of data scientists.

Dr. Rudin presented the report *Graduate STEM Education for the 21st Century*. The report takes a student-centered approach and while acknowledging that the graduate education system in the U.S. is strong, argues that there is a need to change the way that PhD students are trained, given the ways that the world and science are changing. The report also proposes an ideal graduate education and identifies competencies that Master’s and doctoral students should have and apply. He ended with recommendations for incentivizing campuses and faculty to provide the mentoring and exposure to post-education career paths that doctoral students need.

10:45 – 11:45 – Panel 2: *Accelerating Convergence*

Moderator: Dr. Evan Heit, Division Director, Division of Research on Learning in Formal and Informal Settings (DRL)

- *Growing Convergence Research* (Dr. Dragana Brzakovic, Senior Staff Associate, Office of Integrative Activities)
- *The Future of Work at The Human-Technology Frontier* (Dr. Fay Lomax Cook, Assistant Director, Directorate for Social, Behavioral, and Economic Sciences)
- *Harnessing the Data Revolution* (Dr. Chaitan Baru, Senior Advisor, Directorate for Computer and Information Science and Engineering)
- *Convergence Accelerators: A New Model for Research to Innovation* (Dr. Dawn Tilbury, Assistant Director, Directorate for Engineering)

Dr. Heit began with an overview of *convergence*. Convergence represents the highest degree of interdisciplinary study; the future of science and NSF's Ten Big Ideas will depend on large investments in convergence research. He posed questions such as, how can EHR be a good citizen of NSF and encourage collaboration within the scientific community? How can EHR prepare for STEM education of the future and engage with other directorates at NSF?

Dr. Brzakvoic provided further clarification on what NSF means by *convergence research*. This term cannot be concisely defined; it is not a new concept and can be illustrated in fields like bioinformatics and bioengineering. Convergence is research driven by a specific and compelling problem that requires deep integration across disciplines. Convergence research requires developing new scientific language and frameworks to address new areas of research to build a community of researchers across disciplines. One example of a center with large, long-term investments that has been successful in catalyzing research convergences is the Center for Brains, Minds and Machines, a collaboration between computer scientists, engineers, mathematicians, and other disciplines at MIT, Harvard, and Johns Hopkins.

Dr. Brzakvoic also included an update on the work of the NSF convergence working group. Activities include funding for focused workshops and summer schools to build community among researchers in FY 16 and two Dear Colleague Letters in FY17, which resulted in 359 white papers - 14 of which were invited to submit full proposals. EHR is heavily involved in the six research Big Ideas, and can help build convergence research communities.

Dr. Fay Cook noted that EHR, SBE, CISE, and ENG are working together on the *Future of Work at the Human-Technology Frontier* (FW-HTF) convergence accelerator. NSF is starting with defining a few tracks that build on foundational research with specific goals for outcomes and deliverables, and will host workshops to form teams and solicit information from the research community to define additional tracks. Dr. Cook illustrated the ideas with examples from the smart manufacturing environment and smart classrooms.

Dr. Baru discussed *Harnessing the Data Revolution* (HDR), the other Big Idea for which a convergence accelerator is planned. He noted five themes for issues and challenges.

- Science Domains (huge amounts of data are being shared in convergence research)
- Foundations (how research in the given domain is changing, given data needs)
- Systems & Algorithms (developing through problems posed in computer science)
- Cyberinfrastructure (a need to advance cyberinfrastructure)
- Education and workforce (in high demand to support HDR)

He cited the HDR Academy, an education and workforce development initiative that aims to catalog, collect, and create education and training materials, to place postdocs and Research Experiences for Undergraduates (REU) students in positions where they can be cross-trained in the science of their domain and data, and to offer data science boot camps for graduate students, postdocs, and junior and senior faculty. He highlighted the Data Science Corps, which is linking data science students and professionals to data science projects in academia, industry, government, and non-profits, and provided an example of a potential HDR accelerator project, through HSF ASCENDE (Advanced SCience and ENgineering Data Ecosystem).

Dr. Tilbury defined *convergence accelerators* as new organizational structures, as opposed to a center or a grant, that bring together multiple disciplines to work on projects with specific goals. Accelerators will build on work NSF is already undertaking such as I-Corps, NSF INCLUDES, team development through IDEAS LABS, and industry-inspired workshops. She discussed the phases of an accelerator, including team seeding, team formation, and strong mentoring, as well as how EHR might contribute to the innovative curriculum designers, world-class instructors, and intensive training for teams on team dynamics, ideation, communication, and convergence.

12:30 – 2:30 Working sessions for the EHR AC Subcommittees

The Future of STEM Education, Public-Private Partnerships, and Broadening Participation subcommittees met during the AC meeting and summarized their discussions in the next session.

2:30 – 3:30 EHR AC Subcommittees Report-out and Discussion with EHR AC

Broadening Participation

Dr. Debra Pérez introduced the Broadening Participation (BP) Subcommittee, which will report to the AC on recommended strategies for BP that EHR can use for all programs. They plan to meet every other month by phone for at least 12 months. The subcommittee seeks information from NSF on the differences between BP-emphasizing, BP focused- and non-BP programs, as well as demographic data on awardees and institutions. The subcommittee will also look at outreach activities for BP programs and attempts to address BP. Dr. Perez also noted potential alignment with other AC subcommittees. She posed a question about the extent to which NSF relies on certain programs to achieve its broadening participation goals. Dr. Lewis mentioned

the Committee for Equal Opportunities in Science and Engineering (CEOSE), whose vision led to NSF INCLUDES.

Public Private Partnerships

Dr. Elizabeth Boylan introduced the Public Private Partnerships (PPP) subcommittee discussion by noting the NSF Agency Priority Goal of expanding public and private partnerships to enhance the impact of NSF's investments and contribute to American economic competitiveness and security. Such partnerships require a great deal of work and care, and the cost/benefit ratio must be considered carefully. The PPP subcommittee will meet over the next year to address four key questions. 1) What is the problem to address? 2) How can EHR efforts be translated into thematic buckets that programs can hold onto and develop? 3) What metrics can evaluate these partnerships? 4) What principles should guide which PPPs are pursued and established?

Future of STEM Education

Dr. Margaret Honey introduced the subcommittee and reviewed the charge – to develop a vision of the desired characteristics of STEM Education and to use that vision to establish goals for EHR for the next 10 years. The subcommittee is using three strategies:

- Take an expansive view – expand horizons;
- Hear from POs at NSF about their work and ensure that subcommittee work is building on and leveraging the forward-thinking work of NSF; and
- Address important issues of equity and access.

During the AC meeting's working session, the subcommittee heard from NSF program officers about IGE, NSF INCLUDES, Cyber Learning, and ATE programs. The next subcommittee meeting is planned for September.

4:00 – 5:00 Talk with NSF Director France Córdoba

Dr. Rodriguez reviewed the topics discussed during the day and Drs. Perez, Boylan, and Honey provided briefings on the subcommittee discussions. The AC discussed with the Director how preliminary recommendations might be implemented in EHR and NSF more broadly. Dr. Córdoba noted that NSF 2026 meetings will begin this summer to establish new big ideas through the “idea machine” and from diverse participants (the only restriction being that they must be at least 14 years old).

The meeting adjourned for the day at 5:00pm. AC members were invited to join EHR staff for a no-host dinner.

DAY 2: Friday, June 1, 2018

8:45 – 9:00 Welcome Back. Recap of Day 1; Plan for Day 2

Dr. Francisco Rodriguez, AC Chair

Dr. Rodriguez reviewed the Day 2 agenda and invited AC members to raise any questions or ideas they wanted to put forward for further discussion. Topics mentioned included:

- new curriculum needs in data science,
 - an EHR showcase to highlight its work and full portfolio for other directorates/ offices,
 - educating the public regarding digital security in formal/informal settings,
 - an update on NSF's continuing efforts to address challenges in undergraduate education, and
 - ensuring that broadening participation is a part of all NSF programs, not just those with a BP focus.
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9:00 – 9:30 Update on NSF INCLUDES

Dr. Sylvia James, Acting Deputy Assistant Director, EHR

Dr. Don Millard, Acting Division Director, Division of Engineering Education and Centers, Directorate for Engineering

Drs. James and Millard described NSF INCLUDES activities since the last EHR AC Meeting. In January 2018, there was a week of meetings - a summit with 160 participants from NSF centers across the country and a PI meeting with nearly 200 participants from 70 design and development launch pilots. The *NSF INCLUDES Report to the Nation* was released in early February. This was the first major publication for NSF INCLUDES and the beginning of an ongoing NSF INCLUDES communications campaign by the Office of Legislative and Public Affairs. They reviewed the program's theory of change; and key elements of vision, partnerships, goals and metrics, leadership, communication, expansion, sustainability and scale. Next steps include:

- awards under DCL 17-111,
 - funding the Coordination Hub,
 - continued dissemination of *Report to the Nation*,
 - updating and expanding the program website,
 - Foundation-wide Town Hall with Dr. Córdova
 - Alliances awards, and
 - exploring partnerships with other federal agencies and industry.
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9:30 – 10:00 Update on HSI Program

Dr. Talitha Washington, Program Director, Co-Lead HSI Program

Dr. Andrea Johnson, Program Director, Co-Lead HSI Program

Drs. Washington and Johnson provided a review of the HSI Program, which was created at the direction of Congress, and an overview of progress made since the last AC meeting. The goals of the program are to: build capacity at HSIs; increase retention and graduation rates of students in STEM; and focus on undergraduate STEM education.

HSI conferences started in November are will continue throughout 2018. There has been support from Congress at these conferences.

Proposals have been received under NSF 18-524. The solicitation includes two funding tracks: building capacity (Priority area 1 – critical transitions; Priority area 2 – innovative cross sector partnerships; Priority area 3 – Research on BP in STEM) and HSIs new to NSF (to broaden the number of HSIs that receive NSF funding). A resource hub will be funded to support the needs of HSIs with little to no prior NSF funding. Award decisions will be made this fiscal year. A new solicitation is being developed for FY19.

Following the HSI Program update, AC members engaged in open discussion of both NSF INCLUDES and the HSI Program.

10:45 – 11:30 Committee Business Committee of Visitors Updates: HRD and ECR

Dr. Corby Hovis, Program Director, DUE
Dr. Jermelina Tupas, Acting Division Director, HRD
Dr. Dawn Rickey, Program Director, ECR

Dr. Hovis, EHR Committees of Visitors (COV) Coordinator, explained the role of COVs in regularly addressing the progress and priorities of NSF's programs. COVs are a subcommittee of the AC. COV chairs are recruited from the AC and report back to the AC. Presentations to the AC may be reports, or they may be updates on earlier reports. Two EHR programs provided updates on the actions implemented in response to earlier COV reports: Dr. Jermelina Tupas reported on responses to the first division-wide COV in EHR, which took place in 2016 on the Division of Human Resource Development (HRD) and was chaired by Dr. Francisco Rodriguez. Dr. Dawn Rickey reported on responses to the 2016 COV report on the EHR Core Research (ECR) program, chaired by former AC Member Dr. Mark Lipsey.

12:00 – 1:00 Program Highlights

During lunch, program directors presented highlights from selected EHR programs.

- **Advanced Technological Education (ATE)**
Dr. V. Celeste Carter, Lead Program Director, DUE
 - **Graduate Research Fellowships Program (GRFP)**
Dr. Gisele Muller-Parker, Program Director, Office of Integrative Activities
 - **Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)**
Dr. Clytrice Watson, Program Director, HRD
 - **Advancing Informal STEM Learning (AISL)**
Dr. Julie Johnson, Program Director, DRL
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1:00 – 2:00 AC Advice to EHR and Closing Remarks

Dr. Rodriguez closed the meeting with an opportunity for each AC member to express final thoughts or recommendations for EHR. AC members' comments included praise for meeting coordinators, noting that logistics ran smoothly and the presentations were clear, concise, and informative. Advice included:

- Considering an AC subcommittee on graduate education (Marilyn Strutchens and Jim Spillane volunteered to serve on this subcommittee.)
- Providing CEOSE updates in a future meeting
- Identifying data science graduate programs and exploring opportunities to work collaboratively with CISE, HDR, and SBE
- Focusing on math education reform and building infrastructure at multiple levels to make sure new ideas for teaching are supported
- Continuing to advance diversity and focus on intersectionality, not as a moral obligation, but because it is needed for the future success of society

Dates for the next EHR AC meeting were set for Thursday and Friday, October 18-19, 2018.