Directorate for Engineering Advisory Committee Meeting

National Science Foundation
Alexandria, Virginia
October 21-22, 2020
Virtual

ENG AdCom Members Present:
Dr. Sarah Rajala (Chair)
Dr. Leah Jamieson (Co-Chair)
Dr. Tilak Agerwala
Dr. Gilda Barabino
Dr. Robin Coger
Dr. Bruce Horn
Dr. Mary Juhas
Dr. James R. Martin II
Dr. Robin Murphy
Dr. Lance Pérez
Dr. Darryll Pines
Dr. James Thompson
Dr. Stefanie Tompkins
Dr. Jelena Vučković
Dr. Jeanne VanBriesen

Not Present:
Dr. Susan Smyth

ENG Senior Staff Present:
Dr. Dawn Tilbury (Assistant Director)
Dr. Linda Blevins (Deputy Assistant Director)
Dr. Andrea Belz
Dr. Shekhar Bhansali
Dr. Richard Dickinson
Dr. Sohi Rastegar
Dr. Mihail Roco
Dr. Robert Stone
Dr. Kon-Well Wang

Wednesday, October 21, 2020

The meeting convened at 10:30 a.m.

CALL TO ORDER

Members introduced themselves and gave words of advice. and ENG leadership introduced themselves. The committee approved the minutes of the Spring 2020 meeting.

DIRECTORATE FOR ENGINEERING REPORT

Dr. Dawn Tilbury, NSF Assistant Director for Engineering, described the organization of the directorate and introduced new staff and open positions. She described the recent NSF and ENG budgets. She explained that NSF is starting to develop its next strategic plan. Dr. Tilbury summarized investments in the NSF Big Ideas, including separate workshop series to inform upcoming investments in the Future of Work at the Human-Technology Frontier and to identify engineering needs in mid-scale research

infrastructure. Future manufacturing, advanced wireless, artificial intelligence, biotechnology, and quantum technologies remain important areas. She introduced the new Engineering Research Centers and noted that funding for the National Nanotechnology Coordinated Infrastructure was renewed. The Emerging Frontiers in Research and Innovation program and the Convergence Accelerator program are seeking community ideas for new topics. Dr. Tilbury described opportunities for mid-size team research, sustainable regional systems research, disaster-related research, and international collaborations, among others. She honored the engineering achievements of Waterman awardee John Dabiri of Caltech and Nobel Prize winner Jennifer Doudna of the University of California, Berkeley.

Discussion

Committee members asked how NSF was supporting academic researchers during the pandemic. Dr. Tilbury responded that NSF has been flexible about awards and has several committees looking at how to help universities. NSF also communicates with Capitol Hill, the National Science Board, and others about the community's needs. Committee members added that NSF, NIH, and others are funding a National Academies study on the impacts of COVID-19 on the academic careers of women in science, technology, engineering, and mathematics (STEM). The report is expected in the spring.

Committee members asked about the possibility of developing new Big Ideas. Dr. Tilbury explained that NSF plans for the current Big Ideas to continue for five years, and FY 2021 is the third year. NSF is having conversations about how the Big Ideas will develop, for example, the NSF 2026 Idea Machine could lead to new ones, but nothing is firm yet. The decision is up to the NSF director.

Committee members remarked that the pandemic is a tectonic shift, showing possibilities for overcoming geographic and social barriers, for changes in knowledge creation, and for involving diverse voices and perspectives, such as artists and historians. Upheavals in the past led to societal changes and technological disruptions, for example, the GI Bill. Dr. Tilbury added that ASEE is collecting information to understand the impacts and potential opportunities for engineering education, and the Engineering Directorate remains ready to accept ideas at any time.

NSF BUDGET UPDATE

Ms. Caitlyn Fife, Division Director of the NSF Budget Division, provided context about the U.S. federal budget process. Fiscal year (FY) 2020 just ended. She explained that the FY 2021 budget request for NSF was submitted in the spring and the agency is operating under a continuing resolution. NSF has begun discussions of the FY 2022 request within the Administration. She described additional funding to NSF under the CARES Act and NSF investments related to COVID-19.

REPORT AND RECOMMENDATIONS FROM SUBCOMMITTEE ON THE SBIR/STTR PROGRAM

Dr. Mary Juhas, liaison to the **Subcommittee for the Small Business Innovation Research/Small Business Technology Transfer Program** (SBIR/STTR), introduced the SBIR/STTR program and subcommittee and its members. The Assistant Director charged the subcommittee last spring to study and report on two areas: (1) impacts of COVID-19 on the small business community as relates to the SBIR/STTR program, and (2) ways to enhance the geographic and demographic diversity of SBIR/STTR

awardees. The subcommittee is learning about IIP activities that relate to these areas and will continue discussions through the fall.

BLACK LIVES IN ENGINEERING DISTINGUISHED PANEL

Dr. Tilbury welcomed the panelists to the meeting for a discussion about their personal experiences, the barriers to inclusion in engineering, and strategies for meaningful change to increase the participation of people of color in engineering. She introduced the moderator, **Dr. Nakhiah Goulbourne**, NSF program director for Mechanics of Materials and Structures.

Dr. Goulbourne observed that we are experiencing four crises — pandemic, environment, a social crisis, and a financial crisis — and this is the time to create a new path forward. She introduced the four distinguished panelists:

- **Dr. Harriet Nembhard,** Dean of the College of Engineering, University of Iowa
- **Dr. Timothy Pinkston,** Vice Dean for Faculty Affairs, Viterbi School of Engineering, University of Southern California
- **Dr. Tonya Smith-Jackson,** Senior Vice Provost for Academic Affairs, North Carolina Agricultural & Technical State University
- **Dr. Levi Thompson,** Dean of Engineering and Elizabeth Inez Kelly Professor of Chemical Engineering, University of Delaware

Dr. Goulbourne asked the panelists, "What has this moment meant to you?" **Dr. Thompson** explained that he learned how to live in two worlds. He experienced both overt racism and great encouragement during his engineering education. He noted that engineers want to use their skills during a crisis to solve problems. **Dr. Smith-Jackson** said we live in two Americas: one that suggests that all is well, and one (experienced by panel) that has seen police brutality our whole lives. Now, everyone must confront things that Black people have had to deal with all along. She spent much of her life in predominantly white environments and felt unseen in most places. She first felt seen in her high school, where she was told she not need to conform and do all the things that she loved. Intersectionality in engineering is something to share with students. **Dr. Pinkston** grew up in a predominantly white community and was subject to prejudice. When he was selected for a summer internship at Bell Labs for Black, Latino and Native American students, he saw how his interests could solve real world problems and impact everyday life. He sees this moment as a movement and opportunity for systemic change. All of us must respond within our own spheres of influence and capacities to provide more equity for all. **Dr. Nembhard** described herself as a 4th generation educator. Two grandparents went to HBCUs in Georgia, which were an important part of community, even for those who did not attend them. In the face of racism, she has had family and a network to support her and push her forward. We have all been called to advance racial justice. Other disciplines may answer this call more eloquently, through access to voting, health care disparities, or social research methods. But how are we in engineering addressing and advancing racial justice? We have a few examples but need more.

Dr. Goulbourne next asked the panelists, "What barriers have you seen or experienced to increasing diversity and inclusion?" **Dr. Thompson** noted that legislative proposals and changes are appearing in more states and becoming a national issue. We need find ways to attract students back into institutions,

and curricula must be designed to serve all students who enter institutions in order to boost enrollment and graduation. **Dr. Pinkston** said the key to sustained improvements is finding people willing to invest themselves in diversity and inclusion. The world is facing grand challenges and wicked problems, and diverse ideas and perspectives are needed to solve them. **Dr. Smith-Jackson** said we need to challenge notions of engineering and reexamine what it means to be an engineer and use that knowledge. Engineers can see for whom our technologies and systems are not working. Engineering should be as inclusive as possible in theory, method, and application. If technologies disadvantage people who are already marginalized or do not serve the broadest group of people, engineers need to challenge them. **Dr. Nembhard** added that engineers develop technology to solve problems, but when society frames people of color as the problem, solutions can do more harm than good. Where would Black and brown people be today if some technologies were not working against them? In education, student outcomes are affected by easy or difficult interactions with faculty. There are costs to all of us.

Dr. Goulbourne next asked the panelists, "What programs or policies have worked well in increasing access, diversity, and inclusion?" **Dr. Thompson** encouraged partnerships between HBCUs and research-intensive "R1" universities, such as dual degree programs in engineering where students start at HBCUs and finish at R1s. **Dr. Smith-Jackson** described the multi-site NSF Research Experiences for Undergraduates (REU) collaboration involving North Carolina Agricultural & Technical State University and other institutions. The REU provides new and beneficial experiences for African American students who are not from an HBCU, and for white students who become better equipped to work with different people and more culturally competent. Also, companies are seeing value in diversity and inclusion for both research and talent, and focused partnership opportunities between companies and HBCUs would encourage that. **Dr. Nembhard** noted there are many great programs, but their outcomes have been small. New faculty need support from their institutions, through things like dual career hiring programs. NSF can provide financial support and program director support. There may be untapped opportunities to link NSF goals with campus programs. **Dr. Pinkston** added that it is important to encourage diverse precollege and undergraduate students in these careers. Also, the need for minority research initiation awards, which provide many benefits, remains strong.

Dr. Goulbourne's last question for the panelists was, "What can NSF do in this moment to make meaningful changes in broadening participation for people of color? **Dr. Thompson** suggested that NSF look at curricula to make them more amenable to graduating students of all backgrounds. He also recommended a program like ADVANCE for under-represented minorities. **Dr. Nembhard** asked NSF to consider how to build community while building engineering infrastructure, for example, by building faculty cohorts of color to drive the research agenda. She would also welcome a college-level program like Revolutionizing Engineering Departments to advance both research and community. **Dr. Pinkston** noted that when at NSF in CISE, for medium and large proposals, PIs mush have significant broadening participation plan. Take it up a notch, have PIs provide a departmental plan for BP as a document in the proposal. Would incentivize universities and give the PI a framework to address they work that they will do for BP that aligns with plan. Ownership and opportunities for leadership by both. **Dr. Smith-Jackson** suggested NSF think about a creative mechanism to copy what HBCUs do well. HBCUs can lead efforts to teach and develop others. Second, NSF can unveil bias in engineering and research funding, and then create actionable strategies. The Directorate for Computer and Information Science and Engineering

(CISE) had a Dear Colleague Letter on fairness that became part of core solicitations, and this could be a model for ENG.

Discussion
The group discussed the start of an IEEE group on ethical design, which applies to all engineering. Design and implementation must address ethical issues, bias being one of them, especially as intelligent systems become pervasive. We need to expose engineering undergraduates to ethical design from freshman year onward. Ethical issues are equally or more important for faculty and researchers because they are training others.

The group noted that large investments have moved the needle only a little. Engineering schools need to emphasize lifelong learning and cultural competence to be ready for all students and diverse faculty. Programs have anecdotal success stories but need assessment, accountability, and lateral and longitudinal connections. A systems view can identify how programs can leverage each other to change the system into one that welcomes diverse students and faculty.

The group also discussed how to change the popular understanding of engineering. There are untapped opportunities to collaborate with the arts, humanities, and social sciences. Changing language from passive "pipelines" to active "reclaiming" can help students and families understand engineering and see themselves in the profession. NSF could support community transformation as a grand challenge.

ENGINEERING FOR US ALL (E4USA)

Dr. Darryll Pines is principal investigator for the Engineering for US All (E4USA) project. He explained that E4USA is a national pilot program for a high school engineering course. Its goals are to democratize engineering and provide an engineering curriculum for all high school students. He introduced E4USA's multi-university team, objectives, and timeline. E4USA developed a multi-course curriculum sequence in four areas: discover engineering, engineering in society, engineering professional skills, and engineering design. The pilot involves students who are diverse both demographically and geographically, and it provides teacher training. In 2020-2021, the program is partnering with 35 high schools across 11 states and Washington, DC, as well as TeachEngineering.org, and plans to expand in the future to more high schools and universities. With COVID-19, training and teaching are virtual, and project kits for students are mailed to instructors. E4USA researchers are studying for whom and under what conditions does this work. Dr. Pines shared some initial findings for teachers and students. More partner schools are accepting dual enrollment or credit and placement, and E4USA students are going into engineering. In the future, the program wants to increase high school and university partners, expand credit/dual enrollment opportunities, continue improving the curriculum and teacher training, and develop a national assessment, such as Advanced Placement.

Discussion
Committee members asked how a university can become a partner. Dr. Pines responded that E4USA provides the curriculum, and the university provides some funding and a representative in E4USA meetings.

DIVISION OF INDUSTRIAL INNOVATION AND PARTNERSHIPS (IIP) OVERVIEW

Dr. Andrea Belz, Division Director, IIP, introduced the divisions mission, vision, and team. IIP programs help translate discoveries from the laboratory into beneficial technologies by addressing different risks. She described the ecosystem of IIP programs: SBIR/STTR, Innovation Corps (I-Corps), Partnerships for Innovation, Industry-University Cooperative Research Centers, and INTERN. To increase participation of underserved communities in entrepreneurship, IIP began a collaboration with the National GEM Consortium to bring I-Corps to the GEM network and started a postdoctoral fellowship opportunity for conducting research in small businesses.

IIP COMMITTEE OF VISITORS (COV) REPORT AND DISCUSSION

Dr. Eric Johnson, PalmettoNet Endowed Chair in Optoelectronics; Professor of Electrical and Computer Engineering, Clemson University had connection problems, and COV member **Dr. Robin Murphy** presented on his behalf about IIP academic programs. **Dr. Tom Knight**, Founder and CEO, Invistics Corporation, and Founder and Chairman, HealthcareDiversion.org, presented findings about IIP small business programs. Overall, they found the merit review process was appropriate, panel summaries were constructive, and some parts of the review could include more detail. Review panels were appropriate and diverse in expertise, and additional industry representation on academic panels would be beneficial. Program management was responsive to the community and emerging research opportunities. The portfolio of awards was balanced in many dimensions. The need to increase participation of underserved groups among reviewers and awardees was noted. IIP programs perform well and advance the division's mission.

The committee had no questions and voted to accept the IIP COV report.

RESEARCH TRANSLATION

Dr. Tilbury said that there is not a direct line from basic research to translation. Reality is complicated, and translation can lead to new basic research questions in a virtuous cycle. Translational research often leads to commercial benefits for industry, and it can also lead to public or government benefits with societal impacts. NSF investments in research and education have many paths to translation.

- What barriers slow or stop the translation of promising research results?
- What existing leverage points could help reduce these barriers?
- What existing mechanisms to speed/enhance translation should be expanded?

Discussion
Committee members pointed out that sometimes there is no money for the translation of research with high societal value if government lacks funds and industry will not profit.

Translation can be at odds with what faculty thinks is valuable at that time in their career. They may feel the need to choose between the pursuit of a patent and the need to publish. Faculty can be trained to do both, as well as how to value IP realistically. Translation pathways vary among fields. Some universities are not developing their IP or tracking it.

Testing at scale and repeatability are required to make advances in translation. Some national labs and research infrastructure have opportunities for testing.

Translation can also raise new questions about ethics and conflicts of interest. It can be hard to predict how a technology will be used.

PREPARATION FOR DISCUSSION WITH THE DIRECTOR'S OFFICE

Advisory Committee members discussed research translation, broadening participation in engineering, NSF broader impacts, and training in diversity and inclusion. They decided to share these topics with the NSF Director.

The meeting stopped at 5:00 p.m.

Thursday, October 22, 2020

The meeting reconvened at 10:30 a.m.

BROADER IMPACTS

Dr. Suzanne Iacono, Head, Office of Integrative Activities, describe NSF's two merit review criteria, intellectual merit and broader impacts. The criteria have received attention from Congress and the National Science Board. While they have changed over the years, their articulations have many similarities too. The scope of broader impacts is broad and includes broadening participation. NSF reexamined broader impacts during 2015-2017, which led to several actions. NSF funded the Center for Advancing Research Impact in Society (ARIS), a critical organization for NSF and the country to help prospective principal investigators understand how to develop projects. NSF created a video to explain broader impacts to reviewers. NSF also analyzed data about broader impacts, including which broader impacts were described in proposals and reviews. Improving student mentoring, holding more collective impact pilots, clarifying guidance, or doing more data analysis are all potential next steps.

THE BROADER IMPACTS CRITERION: FROM ACTIVITY TO IMPACT

Dr. Susan Renoe, Executive Director, Center for Advancing Research Impact in Society, University of Missouri, said that the spirit of broader impacts has always been part of NSF culture – researchers want their projects to make a difference. Principal investigators might try to do a check list, and we encourage them to think about the goals of their project and what fits. Longitudinal tracking is rare. Investigators may feel a tug of war between doing something new versus something with evidence, but NSF's Proposal & Award Policies & Procedures Guide says either one is good. Some items might be part of every project, like common letters in Wheel of Fortune, but what will set yours apart? Investigators face challenges in funding, time, expertise, other resources. Dr. Renoe offered advice. **Adopt a broader impacts identity**: What do you want people to know you for? How do impacts on society work with your research and other parts of your life? Researchers can do things that fit and align with their research and

their lives. **Create new norms:** The next generation of scientists wants their work to make a difference in people's lives. The community can support and highlight people doing it well. Researchers listen to their peers. **Create broader impacts cycles** to pass along broader impacts. Share knowledge, tools, and resources, like the ARIS Broader Impacts Wizard. **Support principal investigators and reviewers:** Help them to understand broader impacts better and examine them objectively, with tools and guides. The vision is to integrate broader impacts and intellectual merit, evaluate them over the long term, enhance pathways to STEM careers. Broader impacts should be achievable, substantive, assessable, and personal. Dr. Renoe concluded with the Broader Impacts Summit planned for May 2021.

BROADER IMPACTS BREAKOUTS

Committee members discussed ways to improve communication about broader impacts and how to amplify the outcomes and impacts of NSF-funded research.

Dr. Juhas reported that it is hard to find clear information that allows researchers to build on previous moment; NSF could educate principal investigators and reviewers about this. To amplify outcome, NSF could code results and highlights it received about broader impacts to make them easy to access.

Dr. Martin reported that universities can have more alignment with broader impacts, which would help individual investigators as well as evaluation and assessment. Broader impacts are bigger than one entity, so NSF could convene, unite, and build partnerships to align, leverage, and coordinate activities.

Dr. Tompkins reported that sharing NSF's broader impacts analysis, holding topic-specific sessions at workshops on broader impacts, and enlisting the media to share outcomes would all help with communication. To amplify outcomes, translation is essential, as is a shift in university values beyond publications.

BROADER IMPACTS DISCUSSION

Dr. Jamieson noted that all the groups talked about partnerships and what NSF could be doing. We hear about new things that are in place and underway. Why are we still feeling this gap and what would close it, given current circumstances?

Committee members discussed the value that universities put on commercialization. While it is often encouraged, in some local cultures junior faculty are getting a different message. With all the things they have on their plates, it may not take much for junior faculty to deprioritize commercialization. Universities have a long list of values, and people get confused about how to balance and weigh them and how make choices for their career.

REPORT FROM ADVISORY COMMITTEE LIAISON

Dr. Jeanne VanBriesen, liaison to the **Advisory Committee for Environmental Research and Education**, reported that the March meeting was cancelled due to the pandemic. At the June meeting, the theme was how human and environmental health intersect. They formed a subcommittee and will continue

this topic at the fall meeting. Fall meeting included a panel on broadening participation and sessions on human and planetary health; convergence of environmental research and education; co-production of environmental research.

PERSPECTIVE FROM THE DIRECTOR'S OFFICE

Dr. Sethuraman Panchanathan shared his vision for NSF, built on three pillars: advancing the frontiers of research into the future, ensuing accessibility and inclusivity, and securing global leadership. Partnerships in every form underlie the foundation, and an innovation mindset is a thread throughout the agency. We are in a defining moment, with intense global competition, an urgent need for domestic talent, and broad support for science as path for solving global grand challenges. NSF is the bedrock of curiosity-driven research and can respond to emerging opportunities and challenges at speed and scale with the help of partnerships. Interagency partnerships are needed for mega scale projects. Education partnerships are needed for growing people and talent. Translational research partnerships are needed to turn knowledge into action and inspire new fundamental research questions. He thanked the committee for their participation.

Discussion

Dr. Rajala welcomed the Director and Chief Operating Officer Fleming Crim and said the committee was prepared to ask questions.

Dr. Tompkins said that newer technologies do not necessarily have methods to be certified and more widely applied, for example, 3D printing and autonomous systems. How could NSF enable that aspect of translation? **Dr. Panchanathan** responded that rapid translation to get outcomes is something that needs attention and includes faster and better ways to accept new technologies. Trust and verification are important. Partners will be needed to do this effectively and to think about policy from early on.

Dr. Martin shared the committee's interest in an ADVANCE-like program for under-represented minorities and their discussion on the importance of inter-cultural competence. How have NSF investments done on return on investment, and what are the determinants of success? **Dr. Panchanathan** replied that the NSF task force on racial equity is studying barriers and impediments. NSF's work may not reach everyone everywhere, particularly in places where people are being shut out from opportunities. NSF needs partnerships with academia, possibly using a regional approach that includes community colleges and K-12 schools. Partnerships with other agencies and industry partners could expand this further. Your ideas, networks, and influence can help.

Dr. Coger noted that mentors, advocates, and advisors help support people and help them identify as engineers. Has NSF considered how to visibly reward people for this work or broadening participation? **Dr. Panchanathan** responded that accountability and rewards exist at many levels. How can we highlight more of what people are doing? Undergraduates are good at telling stories and speaking passionately about what they are doing. Can reward good work by publicizing. We all have a role to increase the visibility of good work, and the culture needs to permeate universities and professional societies. Individual efforts will be worth more if they are aligned.

Dr. Barabino noted that ADVANCE has not had the same kind of impact for women of color and under-represented men. What would it take for NSF to institute a program like ADVANCE for under-represented minorities? **Dr. Panchanathan** replied that NSF launches programs and pilots, and there may be a pilot on this question. We need to do more to bring the best mentoring and ideas from HBCUs to the forefront. Can our existing infrastructure unleash those ideas in a fair and inclusive way? We are looking at these kinds of strategies.

Dr. Jamieson explained that the executive order on diversity and inclusion caused a lot of discussion and uncertainty about what it will mean for grants. How will NSF implement the order and what are the implications for awards and programs? **Dr. Panchanathan** responded that the order says training can continue for broadening participation and inclusion. NSF is looking carefully at the executive order to make sure to keep true to it, but we are not stopping our approach. We are still working on what it means for grants and how to preserve spirit of inclusion. **Dr. Fleming Crim** added that NSF is not backing off from its commitment to diversity and inclusion. The executive order has the force of law for us, but with careful reading it says we should continue to work on diversity and inclusion and training. We are not now in a position where community needs to act.

Dr. Rajala thanked the Director and Dr. Crim.

REPORTS FROM ADVISORY COMMITTEE LIAISONS (continued)

Dr. Tilak Agerwala, liaison to the **Advisory Committee for Cyberinfrastructure** (ACCI), provided updates on ACCI's four working groups. (1) The Cyberinfrastructure Research and Innovation working group is identifying areas of cyberinfrastructure research that will enable researchers to continue working at the frontiers of science and engineering; this report is expected in the spring. (2) The Reproducibility and Sustainability working group will advise on how the Office of Advanced Cyberinfrastructure can advance these areas and incentivize the community. (3) The Learning and Workforce Development working group received feedback from NSF assistant directors and office heads, and by spring it will have workshop findings and a survey. (4) The Predictive Modeling and Uncertainty Quantification working group is paused for now.

Dr. Gilda Barabino, the liaison to the **Committee on Equal Opportunities in Science and Engineering** (CEOSE), explained that CEOSE is congressionally mandated to produce reports every two years. The last meeting included an update on NSF INCLUDES, a discussion on leadership development, a panel on broadening participation and institutional practices for COVID-19, and a committee discussion about COVID-19 and STEM. The committee also held a working session for their next report.

COVID-19 AND NSF'S RAPID FUNDING RESPONSE

Dr. Louise Howe, Program Director, ENG Office of Emerging Frontiers and Multidisciplinary Activities, serves as co-chair of the NSF COVID-19 Rapid Funding Response working group and chair of the ENG COVID-19 Rapid Funding Response working group. She reminded the committee of previous human experiences with coronavirus relatives. In March, NSF called on the community to address COVID-19 with research proposals in three thrust areas: (1) model and understand the spread of COVID-19, (2)

inform and educate about the science of virus transmission and prevention, and (3) encourage the development of processes and actions to address this global challenge. NSF's three Dear Colleague Letters (DCLs) elicited a huge response, including numerous Rapid Response Research (RAPID) proposals and SBIR/STTR proposals. The CARES Act provided NSF with an additional appropriation of $76 million at the end of March, and NSF spent well over $100 million on top of that for COVID-19-related research and education. Dr. Howe shared the interdisciplinary themes of NSF's COVID-19 awards and the NSF organizations involved. She described research areas funded within the three thrusts and gave examples of ENG-funded projects. More than 30 ENG programs supported awards in response to the pandemic, and community interest continues.

Discussion

Committee members observed that our society will likely be in this situation for one or two more years. We have data on what we have already done, for example, in testing. Do you see threads evolving for data? **Dr. Howe** agreed that some data need to be aggregated at the national level. **Dr. Tilbury** added that NSF is thinking differently about research and can continue accepting proposals in core programs.

Committee members noted that a lot of collaboration is going on and many people and organizations are doing research on an accelerated basis. How does NSF coordinate and select these projects? **Dr. Howe** explained that the NSF working group allowed coordination across the foundation, and NSF supports the formation of communities around topics, such as wastewater surveillance, so that researchers can learn from each other and build on each other's work. NSF funded ASEE to set up a repository. The COVID Information Commons in the community-building phase and is holding research lightning talks that are very well attended.

Dr. Tilbury invited feedback on how NSF can respond. Committee members suggested a study examining how the public responds to evidence-based science.

ROUNDTABLE ON STRATEGIC RECOMMENDATIONS FOR ENG

Dr. Rajala invited to the committee to share thoughts and recommendations.

Committee members encouraged NSF to take concrete action to increase diversity and inclusion. NSF can also mobilize partners.

Committee members saw an opportunity for NSF to capture broader impacts, perhaps with coding the data it receives, so they can be understood and used in stories. NSF could pilot some of the bigger ideas for enhancing broader impacts.

They added that coding and studying COVID-19 projects could give NSF a test case to uncover results and impacts. Big data will play a bigger role in the future and is essential to preparations for future pandemics. Also, the pandemic shows how much health is dominated by engineering.

The committee expressed interest in continuing the meeting topics in the future to build some momentum. Members were also interested in interdisciplinary work for the climate crisis, including ethics, so no groups are left behind.

CLOSING REMARKS

Dr. Rajala and **Dr. Tilbury** thanked the committee members and the NSF team.

The meeting adjourned at 3:45 p.m.