



**Advisory Committee for International Science and Engineering (AC-ISE)
Office of International Science and Engineering (OISE)
National Science Foundation**

**2019 June Meeting
June 18 - 19, 2019**

Meeting Minutes

MEETING PARTICIPANTS

AC-ISE Members Present

Dr. Susan Avery, Chair, Woods Hole Oceanographic Institution
Rear Admiral Jay M. Cohen, The Chertoff Group
Dr. Mary (Missy) Cummings, Duke University
Dr. José A.B. Fortes, University of Florida
Dr. Martha Haynes, Cornell University
Dr. Shafiqul (Shafik) Islam, Tufts University
Dr. Keith Marzullo, University of Maryland
Dr. Anne Petersen, University of Michigan
Dr. Caroline Wagner, The Ohio State University
Dr. Nai-Chang Yeh, California Institute of Technology

Speakers/Presenters

Rebecca L Keiser, Office Head, OISE
Samuel Howerton, Deputy Office Head, OISE
Jessica Robin, Cluster Lead, OISE
Anne Emig, Cluster Lead, OISE
Charles Cunningham, Program Director, BIO
Bogdan Mihaila, Program Director, MPS
Karen Marrongelle, Assistant Director, EHR
Bridget Turaga, Program Manager, OISE
Claire Hemingway, Program Manager, OISE
Matthew Hawkins, Office Head, BFA
Mangala Sharma, Program Manager, OISE
Roxanne Nikolaus, Program Manager, OISE
Douglas Maughan, Office Head, OIA
Frank Rack, Arctic Research Support & Logistics Manager, GEO/OPP

AC-ISE Administrative and Technical Team

Victoria Fung, Program Analyst, OISE
Kirk Grabowski, IT Specialist, OISE

1st Day, June 18, 2019

Call to Order

Introductions and Opening Remarks

Approval of Minutes from Last Meeting

Susan Avery, Chair

Dr. Avery, Chair of the National Science Foundation Advisory Committee for International Science and Engineering (AC-ISE) called the meeting to order and invited the AC-ISE Members and the June 2019 presenters to introduce themselves. The members approved the minutes of the June 18-19, 2018 AC-ISE meeting.

Office of International Science and Engineering (OISE) Overview and Updates

Samuel Howerton, Deputy Office Head, OISE

Dr. Howerton, Deputy Office Head of OISE, described the organizational structure of OISE. He noted that he and Office Head Dr. Rebecca Keiser are a Senior Executive Service duo, and that as career civil servants they will provide continuity to the office that is important for diplomatic relations. He mentioned the three teams in the office, as well as the 15% turnover in staff over the last year. Dr. Howerton welcomed two new members of the office – Dr. Bridget Turaga and Mr. Keith Chanon who cover China and Oceania, respectively – and said that the position for a budget lead was posted yesterday. Noting that OISE continues to be a lean office, Dr. Howerton mentioned that the workload continues to grow. He welcomed the AC-ISE Members' recommendations they provided on how NSF and OISE can prioritize in this changing geopolitical and budgetary environment.

Upon joining the office three and a half years ago, Dr. Howerton set out to streamline the office. Given that the operational budget is only in the tens of millions of dollars, this requires being very strategic. First, OISE has focused on workforce development. Second, the office facilitates and supports international partnerships. Finally, the office takes an advocacy and stewardship role seriously, ensuring the United States takes a leadership role to shape the global science and engineering agenda. Underlying values of meritocracy, openness, and collaboration are intrinsic to the U.S. way of life, Howerton emphasized, and we cannot say all other countries in the world ensure that. Some are rather overt in their differentiation from us. Working with the other directorates, Dr. Howerton continued, the office is keen on ensuring the science structure is moving forward. Dr. Howerton gave an overview of the schedule for the two days of the AC-ISE before taking questions from the AC-ISE Members.

Dr. Shafiqul (Shafik) Islam of Tufts University, a new Member of AC-ISE, inquired about why science and security was a hot topic and specifically whether it was guided by what is going on in the country or by a long-term vision for research. Dr. Howerton indicated that the conversation was motivated by both how science and the innovation ecosystem benefits the country and how science is viewed at the political level. He described the intersection of the protect versus promote political debate, and noted the important role NSF has to play, in particular on promoting science. What we are trying to do internally, said Dr. Howerton, is to make sure the billions of dollars that are invested by the U.S. taxpayer through NSF to the research community receive appropriate oversight. He noted that OISE is thinking about the long-term, as this is an issue that will extend beyond the current Administration. We see a

changing environment in terms of how science is viewed, especially at the political level, he continued. Dr. Howerton indicated that NSF is working closely with colleagues at other U.S. science agencies, especially the National Institutes of Health and Department of Energy.

Dr. Avery welcomed other Members' comments and questions, and called on new Member Dr. Martha Haynes to introduce herself. Dr. Haynes described herself as an astronomer at Cornell University whose research is operational cosmology. She has many collaborations around the world and serves as vice president of the International Astronomical Union for the United States.

Countries and Regions Updates

Jessica Robin, Cluster Lead, OISE

Dr. Robin, lead for the OISE Countries and Regions Cluster, provided an update on the people and priorities of her group. For each program officer, she detailed the countries and research directorates in their portfolios. She mentioned that Dr. Lara Campbell – who manages the Africa portfolio and serves as liaison to the Engineering Directorate – is on detail to the Convergence Accelerator program. Mr. Keith Chanon – a new program officer joining NSF from USDA – is working on Oceania and some of Africa and serves as liaison to the Directorate for Social, Behavioral and Economic Sciences (SBE). Mr. Milan Edgerton works with the group from the administration cluster. Dr. Paul Filmer manages many of the countries in the Americas as well as Egypt and Israel while Dr. Campbell is on detail. Dr. Roxanne Nikolaus manages the EU portfolio, UK, and other Western European countries while also being our liaison to the Mathematical and Physical Sciences (MPS) Directorate. Dr. Sonia Ortega has a multi-region portfolio with many Western European countries as well as Brazil and Mexico and liaises with the Directorate for Education and Human Resources (EHR). Dr. Mangala Sharma manages the Nordic countries, India, and parts of Africa. Finally, Dr. Turaga is our program officer for China, works on the science and security portfolio, and is our liaison for the biological sciences directorate (BIO). It is a big world out there, Dr. Robin notes, and we are trying to cover it the best we can.

Dr. Robin detailed three components of the cluster – representation, policy, and MULTIPLYing Impact Leveraging International Expertise in Research (MULTIPLIER) – and specified that OISE was very interested in getting AC-ISE feedback on the MULTIPLIER program, as this is the new international engagement approach. Moving on, Dr. Robin described the busy schedule of bilateral engagement of Director France Cordova over the last year, including a meeting with the Prime Minister of the Czech Republic which inspired a MULTIPLIER on artificial intelligence (AI). The Director also met with the Vice President of Panama, who negotiated an agreement that resulted in revenue from the Panama Canal going to science and technology. Dr. Cordova met with the outgoing Chilean Ambassador who started a forum on science and technology, and she will be traveling to Chile this fall – home of our largest international investment (i.e., in telescopes).

Then she turned to multilateral engagement, highlighting key events from the past year and the hard work by the staff behind the scenes for the Director's participation in such multilaterals as the Arctic Ministerial meeting, which took place in October in Germany, and the Annual Global Research Council Meeting, which took place in May in Brazil. Dr. Robin also noted that NSF's new policy on sexual harassment has gained a lot of interest with our international partners. She

highlighted the Interdisciplinary Conference on Women & Society in Chile. She also highlighted other events including the Chief Science Officers International Summit for middle and high school students from around the world – where the Director gave inspiring remarks to the science leaders of the future.

Dr. Avery noted that it has been a very active year for international engagement and an extremely impressive list of activities for OISE.

Dr. Anne Petersen of the University of Michigan gave kudos to OISE for explicitly making connections to the research directorates and staffing the Director.

Dr. Jay Cohen of The Chertoff Group commended Dr. Robin for an excellent briefing and noted his excitement about the Chile connection. Chile is not only great in astronomy, he continued, but they are also a stepping off point for Antarctica.

Dr. Islam shared information about his recent trip to Egypt – which was part of a science diplomacy workshop organized by the United States (AAAS), Italy, and Egypt (a library) – and suggested that science diplomacy efforts by different governmental and nongovernmental groups could be combined so that they are more than just one offs. He pondered how NSF can make a big impact in the international space given OISE’s lean budget. He recommended thinking about having concrete metrics at a practical / implementation level, though he also noted that that is not easy. Bill Gates was very smart in focusing on Malaria, Dr. Islam noted, since there are measurable metrics that can be tracked over time. The conference during his visit to Egypt was a regionally focused one that brought together early and mid-career PhDs. They talked about regional challenges, like the difficulty of getting visas to go abroad or finding work locally given the oversaturation of PhDs – and specifically academia – in the region. His second suggestion to OISE was to link-up with a research directorate and identify a focus.

José A.B. Fortes of the University of Florida indicated that he was pleased to see that engagement with Japan was continuing to be extensive even after the closure of the office in Japan.

Programs and Analysis Updates

Ms. Anne Emig, Cluster Lead, OISE

Ms. Anne Emig provided updates from the Programs and Analysis cluster by highlighting the portfolios of the program officers on her team: Dr. Fahmida Chowdhury covers Pakistan, Bangladesh, and South East Asia, while also running tracks two and three of the International Research Experiences for Students (IRES) program, promoting science diplomacy, and increasing awareness among engineers. Dr. Cassandra Dudka’s portfolio includes collaborations with international science organizations. She also co-chairs the National Academies working group at NSF, co-manages our Partnerships for International Research and Education (PIRE) program, and manages Embassy Science Fellows. Dr. Chuck Estabrook co-manages PIRE and serves as the liaison to the Geosciences Directorate, and OISE representative on the Environmental Research and Education coordinating committee member, and a member of the working group on Harnessing the Data Revolution. Dr. Claire Hemingway runs our AccelNet program, manages the Canada portfolio, and serves as liaison to the Office of Polar Programs.

Ms. Elena Hillenburg is the administration team member of our cluster and has been dedicating a lot of effort to our AccelNet program. Dr. Maija Kukla manages collaborations with Russia and the former Soviet countries while running our track one IRES program. Dr. Libby Lyons is currently on detail to the Air Force Office of Scientific Research working on portfolio analysis and horizon scanning in concert with our efforts to build analytics capacity. This detail dovetails with a White House effort to increase coordination among science agencies.

Ms. Emig noted that the cluster has been working for several years to optimize its programs and align them with OISE strategic priorities of advancing researching, developing the future STEM workforce, and leveraging resources through collaboration. We have reoriented our portfolio over the last few years, Ms. Emig continued, to focus on large-scale team science, student professional development, and networks of networks collaboration. Ms. Emig described the inaugural competition for AccelNet that is underway and expects to make awards in September 2019. The focus on building networks of networks is unique. We see room for more growth in community building and community education, she continued. Late in the summer there will be a workshop on data sharing in the context of international networks of networks, Ms. Emig said. There will also be a community building workshop and a workshop on international partnership models for AccelNet in September. We expect each workshop to produce white papers that can serve as a resource to NSF and the community moving forward.

She described the revised solicitation for IRES that was issued earlier in the month, noting the three tracks, and then spoke of an IRES evaluation that would produce preliminary impact data by fall 2019 and a final report by summer 2020. She noted that an IRES workshop on best practices was valuable for knowledge management. PIRE looks at supporting research in large teams. We are in a pause between PIRE competitions, she said, and taking advantage of this time to focus on managing the 2015 and 2017 cohort of PIRE awards. There have been some lessons learned already – for example, we know that they are doing high quality research and engaging high caliber students, however the degree of international experience offered to students varies. A challenge is the integration of research, education, and international partnerships, Ms. Emig continued. Considerations are underway in planning for the next PIRE competition, including coordination with NSF and directorate priorities and taking account of recommendations of the December 2017 OISE Committee of Visitors to consider re-establishing a cap on PIRE budgets and focusing the competition on an NSF priority theme. recommendations of the OISE Committee of Visitors.

Ms. Emig briefly described NSF's involvement with the NASEM Board on International Scientific Organizations (BISO) noting that two significant developments: first, NSF asked BISO to consolidate multiple separate proposals to different NSF directorates into a single consolidated proposal which OISE is managing in coordination with an NSF-wide NASEM working group; and second, OISE will present the BISO proposal review process with a recommendation to the Director's Review Board (DRB) next month (July 2019) for its consideration and approval. She then moved to analytics and horizon scanning where we have looked to build internal capacity over the last year. Paul Morris, Brent Miller, and Libby Lyons have all advanced our capabilities – for example by creating a dashboard so we can better understand the portfolio. We have settled on a standard methodology to assess international activity in NSF's award portfolio, and we can now say reliably that slightly less than one third of all NSF grants include some international activity, she noted. While less than half of that is fully collaborative, it is more than we thought, continued Ms. Emig. We are working to use analytics to inform MULTIPLIER

planning and identify underexplored opportunities.

Ms. Emig described specific areas where the office would appreciate feedback from the AC-ISE Members, specifically what criteria to consider when identifying and assessing potential opportunities for MULTIPLIERS and what role, if any, partnerships should play in OISE's funding portfolio. Dr. Avery asked for additional information on the scale of partnerships, and Ms. Emig described OISE's experience in partnerships that are programmatic in nature like PIRE and East Asia and Pacific Summer Institutes for U.S. Graduate Students (EAPSI).

The Members recalled that OISE had undergone a near death experience until Director Cordova revived it and hired Office Head Dr. Keiser and Deputy Dr. Howerton, noting that the progress presented is incredible.

**NSF's MULTIPLYing Impact Leveraging International Expertise in Research (MULTIPLIER) Updates:
Synthetic Biology (UK and Germany)
Quantum Leap (Japan and UK)**

Dr. Robin introduced the MULTIPLIER session, noting that the challenging nature of the global landscape has led to new opportunities. She said that the office had transitioned to the MULTIPLIER approach from the three overseas offices to ensure that NSF has access to the opportunities, facilities and minds around the world. She introduced the objectives, methodology, and outcomes. Dr. Robin invited Dr. Charlie Cunningham to present on the synthetic cell MULTIPLIER in the UK and Germany. Dr. Cunningham described this effort as a "moonshot" for biology to build a synthetic cell. He emphasized that senior managers in BIO had backed an initial workshop and that the MULTIPLIER trip had come out of that effort. While he was skeptical initially about what could be accomplished by the MULTIPLIER trip in a short time, the participants were able to identify knowledge gaps that were not being addressed by European efforts. These could not have been uncovered by reading the papers alone, emphasized Cunningham, who explained the valuable observation made during the trip that the primary focus of the European research effort was on engineering-led questions while the NSF team was most interested in basic biology questions. The MULTIPLIER team also noted that there was with little apparent attention being paid to bioethics in the European labs visited. He explained that the team returned with a desire to build the US effort around biological questions and have a strong bioethics component built in from the start. They launched an Ideas Lab solicitation and used the new connections to identify mentors and reviewers for the Lab.

Next Dr. Mihaila described the MULTIPLIER on quantum science in Japan, which included a trip to Japan on the heels of the signing of an MOU by Dr. Cordova and the Japan Science and Technology Agency (JST). It was good timing from a U.S. domestic perspective also, given that there was bipartisan support in both the Senate and House for a national quantum initiative. It was time for NSF to start looking more strategically and globally, Dr. Mihaila emphasized, about opportunities for research and collaboration between U.S. scientists and their colleagues abroad. Many of the key research groups are in Europe as well as Asia, specifically China, India, South Korea, and Japan.

Detailing the Japan MULTIPLIER, he noted that OISE's Dr. Joe Miller pulled everything together and that in the planning stages they did a portfolio analysis to try to cover the entire

landscape as efficiently as possible. He said that a diverse group traveled – he as a theorist and his colleagues who are experimentalists – and had significant conversations with their Japanese colleagues directly which lead to a deeper understanding of the level of the scientific research that the Japanese counterparts had. They further understood a second evolution in the field that we will be experiencing within the next decade. We realized, Dr. Mihaila continued, that our colleagues have significant experience in quantum materials, physics, and engineering devices. There is an appetite for convergent and interdisciplinary approaches in the United States and Japan, Dr. Mihaila explained, and we were surprised by the level of integration we saw. That is something NSF hopes to do next, and we are in the process of pulling together a workshop to develop international research collaborations between U.S. scientists and NTT Basic Research Laboratories in Japan, and there could be real opportunities for mutually beneficial collaborations. Japan is not the only country strong in quantum, Dr. Mihaila admitted, and therefore there is also an upcoming MULTIPLIER to the UK.

Dr. Wagner asked how NSF identifies the U.S. partner, or laboratory, that might be interested in doing this type of international research collaboration. Dr. Mihaila responded by describing a bottom up approach consistent with how the scientific community functions in the United States, which means that NSF is in a listening posture. We are in the process of identifying people who we think will benefit from the interactions, then we will invite them to the workshop and charge them with identifying the rest of the community. We seed the conversation, he noted, but it will be their workshop. Dr. Cunningham noted that NSF cannot fund the foreign partners directly, and that one significant outcome of the trip is the research coordination network that has been jointly supported by OISE and the Biological Sciences Directorate will help to bring the best American synthetic cell scientists together with their foreign counterparts on a regular basis. This research coordination network can help those people get together and identify future collaborations and funding opportunities.

Dr. Mihaila completed his presentation reviewing the objectives and then the discussion was opened to the broader group for discussion. Dr. Marzullo inquired about the outcomes of the ideas lab, and Dr. Cunningham noted that while the specific projects were embargoed, and he could not share the details, NSF plans to fund six distinct projects and invest \$18 million. Dr. Marzullo asked a second question about the role of infrastructure in driving these projects, leading Dr. Robin to preview the MULTIPLIER to China that would be discussed later in the AC-ISE meeting.

Dr. Fortes described two objectives – a discovery process to find out the leading-edge research and partnering, and then asked why the national institute of Japan was missing from the list. Dr. Mihaila lamented that while two weeks would have made this possible, the MULTIPLIER trip was limited to one week. Plus, the availability of the foreign counterparts during that specific time impacted the meeting schedule. Further, Dr. Fortes asked about the extent to which the information learned would be available from a state-of-the-art conference on the topic. Dr. Cunningham reminded the group that the UK and Germany MULTIPLIER was scheduled around such a conference, and that that was valuable for a broad perspective on the research in region. When conferences are coupled with site visits to the individual principal investigators and their facilities, the NSF team can get the most comprehensive and insightful perspective of the research status. Dr. Cohen asked whether Quantum Leap was referring to quantum computing, and Dr. Mihaila indicated that it was broader than quantum computing. The National Quantum Initiative includes quantum communication, computing, simulations, and sensing. Dr.

Cohen mentioned his experience on the business side and emphasized that quantum computing is a game changer with financial, communication, industrial, and security implications, and that if NSF does not have its foot in it, we will suffer the consequences. Dr. Howerton described the depth of NSF engagement in quantum activities and noted the work the White House Office of Science and Technology Policy (OSTP) is doing to coordinate related activities across the U.S. government.

Dr. Nai-Chang Yeh from the California Institute of Technology sought broader clarifications from the presenters and asked about the objectives of the MULTIPLIERS, outcomes like the Ideas Lab, and opportunities for joint solicitations through the core programs. Drs. Cunningham and Mihaila addressed specifics for their trips, and Dr. Robin spoke more broadly about the toolkits given to MULTIPLIER teams and the multitude of ways that NSF develops these collaborations. Dr. Cohen indicated that he was glad to hear the synthetic biology group was considering the ethical components of the technology and scientific breakthroughs. Dr. Islam asked questions about how the specific topics to discuss or explore are selected for MULTIPLIERS. Dr. Robin indicated that there were not preset questions for the synthetic biology MULTIPLIER but that moving forward, the groups would have more time to plan and would be more strategic. Dr. Avery summarized, noting that OISE can add value to advancing science through the MULTIPLIER program but that we will have to experiment a little bit if we are going to save the planet. There is an urgency in working on these topics, she said.

Working Lunch: Discussion on Preparing the Future Workforce Globally Karen Marrongelle, Assistant Director, EHR

Dr. Marrongelle began her presentation laying out three things that she planned to do: Tell the AC-ISE about past NSF-wide efforts to provide students with international research experiences, talk about NSF's new initiatives, and think together about future opportunities. After sharing her background, Dr. Marrongelle talked about the 10 Big Ideas, noting that they point to the importance of ensuring that we have international partners working with us on the thorny problems that we cannot effectively address alone. She gave examples of past and current efforts including the Research Experiences for Undergraduates (REU) program, IRES, Non-Academic Research Internships for Graduate Students (INTERN) initiative, Global Sustainability Scholars program, and outreach to community colleges.

She invited the group to think through what we need to do to prepare the next generation of global scholars. Should NSF continue what it has done for years, she asked, or consider different approaches? And finally, Dr. Marrongelle inquired, should NSF target different groups for example underrepresented groups in STEM?

Dr. Yeh asked whether NSF funds students attending international conferences or doing experiments at major international facilities. She emphasized that this kind of support would not be that expensive but can really broaden their horizons. Further she expressed support for the INTERN program and asked how the right companies were selected to optimize the impact with a small budget. Dr. Marrongelle described the process of applying for supplements to NSF awards to allow students to work with companies in the INTERN program.

Dr. Wagner noted that students are regularly using video and new technologies. She suggested a summer program where students from three or four different countries get together to produce

a video product that would have a wider distribution, noting that they could use low-cost technologies that are already available. Dr. Marrongelle agreed that when travel was not possible we can use technology to promote scientific sharing as well as cultural sharing. She indicated that some NGOs are doing this, and Dr. Cohen added that NGOs put together competitions and might have recommendations for engaging high school students. Dr. Cohen further noted his support for the video technology suggestion and took it a step further to suggest a hybrid approach in which a face-to-face interaction in the foreign country followed a video project. The group agreed that relationship-based, long-term experiences can be lifechanging especially for these young, formative minds.

Dr. Fortes spoke of the importance of sustained collaborations in order to see the outcomes of international collaborations, which in this case means ensuring that students have more than a one-week experience.

Dr. Islam described structural problems in the academic research system in which we prepare students for academic jobs when 80% of them will not be able to get them. He expressed support for the INTERN program. Dr. Avery encouraged him to direct these suggestions to universities and their academic administrators. She agreed that the departmental structures limit creativity and recommended that universities use interdisciplinary program models to pull talent together across the university instead of siloing graduate students in single departments.

The group discussed the topic of reaching underserved communities including rural communities. Dr. Haynes mentioned that it is not only students but also teachers who don't have access to research experiences because they are overloaded with intense teaching loads. Dr. Marrongelle agreed that experiences for teachers – including through international research exchanges – would help them stay on the cutting edge themselves. Dr. Yeh suggested partnering with scientific societies to amplify the impact of NSF dollars, noting that the American Physical Society recently released a report on international students. Dr. Avery noted that many professional societies are approaching their 100-year anniversaries and as they are more and more international, they offer more opportunities for students to get involved in international conferences.

Dr. Marrongelle and Dr. Rebecca Keiser, Head of OISE, thanked the AC-ISE Members for their input in this session and expressed interest in receiving more feedback as NSF's strategy on international research experiences and workforce development develops.

Science and Security

Rebecca Keiser, Office Head, OISE

Dr. Keiser set the framework for the science and security session by emphasizing the importance of balance: maintaining the valuable open research ecosystem while addressing concerns about the risks that are in the system. She pointed back to National Security Decision Directive-189 (NSDD-189) defining fundamental research: "Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community." This was released at the presidential level in 1985, when there were Cold War discussions about how open research should be given Russian influence, Dr. Keiser explained. It builds on a 1982 National Academies' study. If you read these now, she said, you will see that it all still applies today. The difference is, she noted, that we have new technologies today. An important part of our goal is to maintain openness,

collaborations, and the values that have made our ecosystem. But countries that are not democratic don't share our values at the governmental level, she cautioned, which creates some risks and puts pressures on individuals in their systems.

Dr. Keiser emphasized that NSF is a strong supporter of international collaboration. You cannot get away from the understanding that science is global, she continued by detailing the broad, positive impacts of international collaborations. Then, using artificial intelligence as an example, Dr. Keiser demonstrated that in a bottom up manner, scientists from the United States want to collaborate with researchers in a wide range of countries around the world. The field is diverse and broad in terms of international partners, but also in terms of topics. Artificial intelligence (AI) includes work on everything from machine learning to materials science to climate change. She referred back to NSDD-189, noting that there are discussions about changing the definition of fundamental research and restricting some subject areas. How could you make a blanket statement that all of a field like AI is going to be restricted, she inquired. Dr. Avery asked about these discussions, and specifically whether the suggestion is to restrict the tool development or the use of the tool. Dr. Keiser indicated that it was unclear, but that it was economic and security risks that these discussions were hoping to mitigate against. But you cannot restrict this entire complex research field, she said. The way basic research advances is that you get results out there, others improve on them, and the field advances.

Dr. Keiser turned to the topic of foreign talent in the United States, noting the significant and important role that temporary visa holders play in the science and engineering talent pool. Then she defined the risks as falling into three categories: research integrity, national security, and economic security. NSF is seeing cases of risks to research integrity, she noted, and this is NSF's focus. We are emphasizing disclosure, as we need to be able to assess conflicts of interest and conflicts of commitment to protect information until our PIs are ready to release that information. Since 1978, she recalled, NSF has required that anyone who submits a proposal to the Foundation disclose all forms of foreign and domestic support. I understand there is some confusion, she continued, and we put new language in the Proposal and Award Policies and Procedures Guide (PAPPG) to clarify what is required. This is not a change in policy, but a clarification. NSF will soon be using SciENCv, as NIH does, for the biographical sketch, and this should decrease the administrative burden for the research community.

Dr. Keiser described work with an independent group called JASON to characterize the risk to our science ecosystem, study the balance between risk and openness, and make recommendations in a public report by the end of the year. She also indicated that the White House Office of Science and Technology Policy had a subcommittee with interagency participants on the topic.

Dr. Avery described reproducibility as one of the fundamental tenets of protecting the integrity of the research environment. If you create an environment where the ability to reproduce another's results is limited, she warned, then you have defeated a fundamental tenant of doing research.

Dr. Yeh called science and security a very sensitive topic. These days, she said, people with creative ideas might have a start-up and collect venture capital funds. Caltech teaches researchers good practices for economic security and encourages filing of provisional patents to give the innovators one year of protection. On the other hand, she continued, we could use

some guidance on risks to national security in areas like quantum and nano science. As a scientist you want to have open exchanges, she explained, and scientists do not always know where to draw the lines. A physics colleague did not know and got into trouble, she lamented.

Dr. Cohen described new technologies like the internet which make people including researchers vulnerable to state hackers. Congress is very aware of this vulnerability. While Caltech may encourage some inventors to apply for patents, he said recalling Dr. Yeh's experiences, other people are afraid that filing for any kind of patent exposes what they have discovered, as well as its utility. These people want to keep their secrets in house. I do not have the right answer, he said in summary, but there is a role for NSF.

Dr. Wagner called this an issue of scale, noting that China has increased its capacity to absorb information and act on it. While top Chinese scientists may still stay in the United States, she said, in Europe they are successfully recruited back home. How do we keep the best and brightest in the United States, she asked. There is no organization or institution pushing back on the different groups that suggest that academic research should be more careful. I would love to see a statement or a manifesto of openness and what it means, Dr. Wagner recommended, suggesting the AC-ISE would be a good organization to think about this. Dr. Yeh underscored one of Dr. Wagner's points, indicating that the open and inclusive American society has historically made it easier for foreigners to integrate here in ways that they haven't in Europe. However, Dr. Yeh warned that the toxicity in the atmosphere in the United States for Asian-American colleagues now is very counterproductive.

Dr. Keiser emphasized that there needs to be more communication about what we can do to preserve the open system, admitting that she is also worried about the fear. We want to communicate about the importance of disclosure, she continued, because the individual cases of nondisclosure are creating panic in the system.

Dr. Cummings from Duke University highlighted the significance of two economic angles of this issue. First, if we took every Chinese student in U.S. engineering graduate schools today, our engineering schools would collapse. On the flip side, the Chinese are giving big money and big promises to recruit our intellectual capital. It's not just Chinese people going back to China, she emphasized, but now there is a new pathway for Americans to go to China.

Dr. Islam suggested that NSF may need to come up with a more nuanced definition of what we mean by science. Dr. Cohen warned that if we left it to Congress to define fundamental science, it may give us an answer we may not like. Dr. Keiser indicated that this was in part why NSF felt that it needed to take steps to protect the integrity and ethical conduct of research and ensure disclosures.

Dr. Wagner suggested the group consider forming a subcommittee to review the literature on this topic, and Dr. Fortes expressed his support. Dr. Cohen recommended asking Dr. Cordova whether this would address the challenges NSF is facing now. Dr. Avery asked what other science funding agencies are doing, and Dr. Keiser detailed DOE and NIH's actions and priorities. Dr. Petersen emphasized that U.S. federal agencies need to work together. Dr. Fortes noted that academic institutions and professional societies also have a role to play. Dr. Islam questioned the responsibilities of NSF, academic institutions, and individual researchers, and he further noted the complexities of finding solutions with pragmatic and principled aspects.

Preparation for Meeting with NSF Director Susan Avery, Chair

Prior to the meeting with Director Cordova, the AC-ISE Members reviewed the morning's discussion and decided on priority topics to address. Dr. Avery opened the session remarking on the evolution of the office and its programs, which she, Dr. Petersen, and Dr. Fortes have observed as the longest serving Members. OISE and the presence abroad has been restructured, there is a new attention to analytics, and new programs, she continued. This transformation, recommended Dr. Avery, would be an appropriate place to start for the meeting with the Director.

Dr. Keiser reminded the group of OISE's close working relationships with the research directorates, and how the office is integrated rather than standing alone. Dr. Islam recommended that each research directorate allocate a specific budget for international work. Dr. Marzullo suggested that the AC-ISE invite Assistant Directors to the next AC-ISE, share this idea with them, and get feedback before presenting it to Dr. Cordova.

Dr. Islam suggested discussing NSF's work to create a globally engaged workforce with the Director. Drs. Yeh, Wagner, and Cohen noted the importance of the topic science and security, and decided on aspects of the issue that both could raise with the Director.

Meeting with NSF Director Susan Avery, Chair

Dr. Cordova opened with special thanks for all of the AC-ISE Members for their service to NSF. Remarking on how active the international engagement has been over the last year, she said that it seemed that NSF had the entire world in our building since the last meeting. She noted that active global engagement would continue, as she was assuming the role of Vice-Chair of the Governing Board of the Global Research Council and traveling to Iceland for the Arctic Circle event in 2020.

Dr. Avery suggested, and Dr. Cordova agreed, that the group first discuss the reorganization of international at NSF. Speaking frankly, Dr. Avery recalled the chaos in OISE when they started five years ago. Under your leadership and Dr. Keiser's leaders, Dr. Avery said to Dr. Cordova, we have seen a major transformation in the office. Collaborations with the research directorates are active. Dr. Petersen added praise for the transformation and noted the very small office budget with which a great deal is accomplished and leveraged. She recalled that approximately one third of NSF grants include an international component and that about half of those are genuine collaborations. Turning to the MULTIPLIER program, she remarked that the power of the program was impressive. Dr. Avery noted that through the MULTIPLIER program, NSF was able to get its experts into see what the host countries were and were not focused on and accomplishing. Dr. Cordova indicated that the financial world was the inspiration for parts of the MULTIPLIER program including observing what people do day-to-day, what they know and value, and what they don't know that we might know.

Dr. Avery suggesting moving on to discuss workforce development and the importance of creating a globally engaged citizenship. Dr. Islam started with the numbers: \$49 million annual

budget for OISE and \$7.1 billion annual budget for NSF. He noted how thankful he was for NSF's continued support over the course of his 30-year career. One of the mandates of NSF, according to Dr. Islam, is the development of a science workforce and the creation of globally engaged citizens. Dr. Islam said that over 80% of PhDs in science and engineering will get jobs outside of academia, and therefore we must be thinking more broadly too. He emphasized that the world is global and that we must innovate and collaborate, especially internationally. Dr. Islam recommended inviting the Assistant Directors to the next AC-ISE meeting to brainstorm for ways to add international components to all of their project budgets. Dr. Marzullo said that a scientific and engineering workforce that is trained internationally and thinking internationally is important. Anything that NSF can do to help build up that base, he continued, is going to be important. Dr. Yeh mentioned that scientific and professional societies also have an important role to play in the development of a globally engaged workforce.

Dr. Cordova replied that for many projects and research – including those which have been big news in the last few years – the international components are intense and also natural. Students therefore also learn of the importance of international collaborations because they are working with people and across cultures all of the time.

Dr. Avery redirected the conversation to the final topic: science and security. She noted the importance of the topic, and assuring the Director that all Member's embraced it, but cautioned that they also want to make sure that it is done respectfully and cautiously, in order to protect some of the very fundamental tenets of research and science. The Advisory Committee is here to help you, Dr. Wagner emphasized, and many are concerned about colleagues (often Chinese) who have been asked to leave their universities or perhaps even the United States. We also hear Congressional concerns about security issues around facilities and our research topics. Finally, we hear from colleagues in overseas locations – especially from China – where there is concern that some doors will close. I know, continued Dr. Wagner, that the openness of science has always been balanced against our security and issues related to security. The issues are not new, but the scale of the issue is greater. The concerns are more acute. We would like to begin by learning about your perspective, Dr. Cordova, including what you need from our AC-ISE and whether you would welcome a subcommittee to think more about this.

Dr. Yeh said that science is without borders. She noted that it is tricky to talk about science and security. She shared best practices from Caltech, in particular on conflict of interest. Dr. Cohen began by noting that this was the best AC meeting he had the privilege of participating in. On science and security, he noted that it was not just conflicts of interest but also conflicts of commitment that could be concerning. He described some of the stories that are in the media as descriptions of unethical behavior. As NSF moves forward, he recommended ensuring that disclosures are complete and done in an honest way. He welcomed hearing from the Director, as he indicated that the group did not want to solve a problem that NSF did not have.

This is one of the defining issues of our time, Dr. Cordova said referring to science and security. How we react to it in every sector will be extremely important to maintaining the balance of openness and security to ensure no sledgehammer comes down and brings harm, well intentioned or not. I've been involved since the early 1980s, Dr. Cordova recalled, and there have been lots of NRC reports. Some elements seem familiar, said Cordova, but there are new dimensions like the internet. There are countries that are stronger than in the past. We are very familiar with theft, Dr. Cordova, noted, but when it is on a national scale, there is a national fear

about it. The lines between fundamental and classified research are now blurred, as even our most fundamental research has been linked to economic success. Now there are conversations across all of the U.S. government, from defense to economic advisors. There are bills in front of Congress to support more National Academies roundtables. They want all of the players to be aware of the hazards, she indicated. Agencies like ours are trying to be as thoughtful as possible, including about what we required of our grantees and internal people. We do not want to go overboard in one direction, but we really need to protect research.

As Dr. Keiser shared with you, Dr. Cordova continued, NSF is taking action. We have had disclosure requirements since 1978, but they were not really understood. We will have new disclosure forms. We have also commissioned JASON to conduct a risk analysis and come back with recommendations. We also value your perspective and any recommendations that you have on training people so that they ultimately do the right thing to protect the research environment.

I was at Caltech last week, Dr. Cordova continued, and 40% of the students were from other countries. I was at Dartmouth the week before, and the same thing. We have a lot of foreign participants at the undergraduate, graduate, and faculty level, and they have helped make us a wonderful success. We have to protect this and enhance the best features. We need to better understand the risk, and value hearing about what your organizations are doing, so that we can spread best practices.

Dr. Avery thanked Dr. Cordova for her reading of the issue. She recommended that U.S. government agencies harmonize so that NSF, NIH, and DOE do not all go in different directions. Dr. Cordova indicated that each agency had to address the concerns specific to its portfolio. DOE is concerned about nuclear proliferation, for example, and that is not within NSF's portfolio. Chief Operating Officer Dr. Fleming Crim reflected on Dr. Yeh's comment about the power and educational benefits of disclosure. We think disclosure of conflicts of commitment and conflicts of interest is important and can move the whole enterprise forward. Dr. Keiser added that NSF is focusing on the actions that it can take. This includes gathering and sharing best practices. She agreed that disclosure and awareness is key.

Dr. Cordova noted that there is no perfect solution. We are not going to put a wall around us, she specified, because in order to be a first-rate country, we have got to be open, out there, and collaborating with allies. We have to be realistic, Dr. Cordova emphasized, and learn the risks, then mitigate against the risks. We commissioned JASON to give us additional insight into this. One example is foreign talent recruitment programs. If you are in one and you promised something to a foreign government that is of value to them and is valuable to us, we may have to close the door.

Dr. Avery began wrapping up the session, and asked Dr. Cordova how things were going more broadly. The Director remarked on NSF's budget, and summarized a town hall and the enormous amount of progress on the 10 Big Ideas. Dr. Keiser referred to a possible international collaboration strategy for the Big Ideas, noting that the staff working on the Big Ideas is often so busy that they don't have time for international thinking. Dr. Cordova recommended bringing the Assistant Directors to a future AC-ISE meeting to talk about the international components of the Big Ideas.

NSF's MULTIPLYing Impact Leveraging International Expertise in Research (MULTIPLIER) Updates: (continued)

Large Facilities (China)

Matthew Hawkins, Office Head, BFA

Claire Hemingway, Program Manager, OISE

Nancy Sung, Senior Advisor, BIO

Dr. Matthew Hawkins (BFA), Dr. Claire Hemingway (OISE), and Dr. Nancy Sung gave a preview of the July 6-16, 2018 MULTIPLIER to China and reported on progress since the trip nearly a year ago. The objectives of the trip included to advance China's engagement in the Group of Senior Officials (GSO), Dr. Hawkins explained, which is a working group of the G-7 but also includes other countries that have large investments in global research infrastructure. The GSO is about building a good practice framework around the principles and practices of integrating research infrastructure globally. It is important to bring China to the table for these discussions, because reciprocity of data and access are big issues with the Chinese partners. In addition, he continued, we set out to explore international expansion of distributed infrastructures such as NEON, improve our understanding of China's research infrastructure, and build or maintain relationships with Chinese counterparts like the Ministry of Science and Technology and the Chinese Academy of Sciences to meet our objectives. The last objective was particularly important because of the timing of the MULTIPLIER trip. It was when the NSF overseas office in Beijing was closing, and so the group had the opportunity to take advantage of connections and expertise of the head of that office, Dr. Sung, and locally employed staff Sun Bo while making direct connections to utilize going forward.

The group visited three primary sites: the large neutrino detection facility called the Jinping Underground Lab (CJPL), the large telescope FAST (Five-hundred-meter aperture spherical telescope), and the China Ecosystem Research Network (CERN). This was a nice mix of facilities that China was investing in, all at a different level of maturity and in a different place for international collaboration including with the United States.

Dr. Hawkins described advancement with China as a direct result of this trip. Before this MULTIPLIER, China was a sporadic and inconsistent participant in the GSO and other international conversations. Since then, China attended three meetings, and China will host a fall 2019 meeting in Shanghai. There is no question that this is the direct result of this MULTIPLIER, Hawkins emphasized.

Dr. Hawkins explained how he proposed the underground laboratory case study and demonstrated how the criteria including reciprocity and data sharing applied and how the partnerships would be managed. He brought this to the GSO membership and showed how China would align with this good practice.

Dr. Sung discussed CERN in the context of BIO's work to support National Ecological Observatory Network (NEON) in the United States. With NEON, she indicated, the data are already available, and many countries are downloading it. It is to our advantages if other others make their data available too, Dr. Sung argued. A collaboration with CERN could be powerful. It will also be a test case, she indicated asking whether China can share its data with the rest of the world through this mechanism.

Ms. Emig inquired about what would have been possible without an NSF office in Beijing and whether this MULTIPLIER went beyond what would have been possible by an overseas office alone. Dr. Sung said that in many places in the world you would not need an office to put something like this together. But at that time and in that place [China], having an office was essential, she concluded. Dr. Hemingway noted that there was also a PIRE project and workshop in China at the same time and that this was key to making the visit to the underground facility possible.

Dr. Avery asked how confident the presenters were that the data quality from China's CERN would be equivalent to the U.S. NEON. Dr. Hawkins indicated that this was a fundamental question for the workshops on the Global Environmental Research Infrastructure (GERI) Initiative to answer. GSO and GERI mutually reinforce one-another in their missions, he continued.

Dr. Keiser noted that these presentations gave a sense of the different types of purposes of MULTIPLIERS. With the synthetic biology MULTIPLIER in Europe, she continued, we knew there were some capabilities and we were able to tailor our understand on a specific journey based on the European strengths. With China we had an opportunity to see things on the ground and learn without much prior knowledge. There was an exploratory nature to this one, and we were also able to build relationships that we can now capitalize on through the GSO including on the values of openness and reciprocity. The flexibility of the program is good. Follow-up is critical and must be built into the MULTIPLIER effort.

Dr. Avery noted the value of seeing three different MULTIPLIERS and the creative thinking to accelerate the science. She asked about the next steps which kicked off the next session.

MULTIPLIER Going Forward
Rebecca Keiser, Office Head, OISE
Jessica Robin, Cluster Lead, OISE

In the final session of the day, Dr. Keiser and Dr. Robin shared the lessons learned from the initial MULTIPLIERS. Dr. Keiser described the plan for FY2020, including the creation of smaller fact-finding trips as precursors to full MULTIPLIERS. In addition, she shared the intent to establish standard analytics to help identify opportunities for MULTIPLIERS, as well as reporting and tracking mechanisms. To expand the program in these ways, MULTIPLIERS will have to be staffed up.

Dr. Keiser called upon Program Director Dr. Roxanne Nikolaus to preview the quantum leap MULTIPLIER that she was planning for the UK in September.

2nd Day, June 19, 2019

Strategic Visioning Update
Samuel Howerton, Deputy Office Head, OISE

Dr. Avery welcomed the AC-ISE Members for the second day of meetings. She reflected on the previous presentations and discussions and commented that she was really pleased with the data analytics aspects of the work, as well as better integration of OISE with the research directorates.

Dr. Howerton called Strategic Visioning for Global Engagement a forward-thinking activity, rather than a completed product. It is influenced by the science and security discussion we had yesterday, he noted. Dr. Crim made an observation that each directorate is engaging in international cooperation, he recalled. Is there an overarching goal, principle, or guidance for the Foundation on international, Dr. Howerton asked. We created an internal working group with representatives from diverse parts of the Foundation. Over the course of four months a small group went through a visioning exercise to generate a document, he explained. It was important that this document be useful for the research directorates and remember as you evaluate our plans for the strategic visioning work, that NSF – like the scientific research community – is a bottom up organization.

To promote an integrated, foundation-wide international engagement strategy requires strategic goals that align to the overall NSF mission and guiding principles. To that end, the group identified three additional values – Championing, Partnering, and Understanding - as guiding principles for international collaborations. These additional values complement the core values identified in the NSF Strategic Plan and guide the foundation’s strategic goals for global engagement. These three additional values involve:

Championing

- Advocate for and advance U.S. science
- Promote the importance of international scientific engagement
- Advance NSF positions at the intersection of science and foreign policy

Partnering

- *A priori* consideration of the benefits of cooperation
- Equitable sharing of results
- Engagement across the global scientific landscape

Understanding

- Recognize and respect cultural and geographic differences
- Safeguard scientific values
- Foster openness with international partners

Then the group defined three strategic goals for international engagement:

- Enhance the U.S. research capability
- Achieve a globally-engaged U.S. STEM workforce
- Achieve globally-accepted science and technology policies and practices

The last goal is relevant to the science and security discussion we had yesterday, Dr. Howerton explained. There is now a larger discussion about the policies and practices we want to use, not only within NSF or even the U.S. government, but that we hope will propagate into the global landscape.

Finally, Dr. Howerton explained the three NSF criteria for international collaboration:

- Mutually beneficial; complementary strengths in evidence
- Provides international experiences to students or researchers
- Provides access to unique opportunities, sites, or infrastructure

In the remaining few minutes, the AC-ISE Members provided feedback. Dr. Marzullo called the criteria for international engagement excellent and described the first bullet as the hardest one for NSF program officers to understand. He recommended an educational process within the foundation to explain the criteria. Dr. Petersen pointed out that “international experience” is a vague term, and Dr. Robin clarified that NSF is specifically referring to international scientific research experiences, including for students and early career scientists. Dr. Fortes recommended changing the word complementary to synergistic in the first bullet under criteria for international collaboration. Dr. Wagner noted that the current descriptions did not account for distributed bottom up international activities. For example, during the human genome project, tasks were distributed to allow 24 hours a day of work to leverage or supercharge the pace of progress. Engaging with six partner countries in this way also built political goodwill, she added. Dr. Wagner recommended adding another criterion to indicate that some international partnerships increase capacity in a way that would be a more efficient and effective use of capabilities and money (i.e., leverage resources). Dr. Cohen supported the inclusion of cultural awareness, calling it very insightful and well done. Dr. Haynes emphasized the importance of reciprocity, indicating that both sides need to feel that they have something to give and something to receive to maximize the likelihood of real success. Dr. Avery remarked that some other countries can make commitments for longer periods of time than NSF can, giving them the ability to think and act strategically, especially on infrastructure projects. I wish there was a way for NSF to think more in terms of long-term strategy, Dr. Avery recommended.

NSF Engagement in International Multilateral Efforts

Mangala Sharma, Program Manager, OISE

Roxanne Nikolaus, Program Manager, OISE

Dr. Mangala Sharma, OISE Program Manager, presented on the Global Research Council (GRC), a multilateral virtual organization of the heads of science research councils worldwide. OISE coordinates NSF’s participation in the GRC. Regardless of how small a country is or how small the percentage of its GDP that supports research is, it gets one seat at the table, indicated Dr. Sharma, as we are all reaching for the same goals. Currently there are about 50-member countries that attend the meetings, Dr. Sharma continued. The idea of the Global Research Council is to promote the sharing of effective practices for research support and research funding and to build networks of cooperation among these different funding councils.

NSF continues to have a leadership role, having spearheaded the formation of the GRC, said Dr. Sharma; Dr. Cordova was elected to be the vice chair of the governing board. The governing board sets the priorities and the direction for the Global Research Council; they meet by teleconference every few months. NSF has committed to host the 2019 regional meeting with our counterpart in Chile in October, and it is likely Dr. Cordova will participate.

Each annual meeting focuses on one or two themes, and depending on the themes, there are also statements of principles that every head of agency endorses, explained Dr. Sharma. There is always extensive input into the statement of principle, she indicated. The themes have covered a wide variety of topics such as scientific merit review and research integrity. Recently, the GRC tackled whether grant funding agencies should be focused on the economic and social impact of the research they fund.

Dr. Wagner noted that from the photos it appears that there is gender balance in representation in the meetings. Dr. Robin indicated that diversity has increased over the past few years but was not the case at the start. Dr. Islam noted that including women – especially in meaningful ways – was important but also a challenge for science in the United States and around the world. Dr. Marzullo inquired whether there were representatives at the state or provincial level, as some countries’ funding comes from these governments. Dr. Sharma indicated that they were represented at time, and that Sao Paulo was an example. Dr. Marzullo suggested that the erosion of trust in public and private institution seems like a key topic for conversation in the Global Research Council. Dr. Sharma indicated that public engagement is one of two priority topics for the upcoming meeting.

In her last few minutes, Dr. Sharma briefly summarized the Carnegie Group Meeting of Science Ministers as informal, off-the-record meetings for science ministers to discuss major science and innovation issues and policies. The 2018 meeting was hosted by Canada, and the 2019 meeting will be hosted by Germany. OISE coordinates U.S. participation, Dr. Sharma continued, and discussion topics include citizen science, artificial intelligence and its impact on the workforce, and evidence-based policymaking for science, technology, and innovation. She wrapped up with a brief mention of the G7 Science Sherpa Meeting.

Dr. Roxanne Nikolaus then presented on the second Arctic Science Ministerial which was held in Germany in October 2018. The meeting purpose was to discuss cooperation in arctic science, challenges and joint actions. The goal of the gathering, Dr. Nikolaus explained, was to strengthen international cooperation in Arctic research by bringing together science ministers but also representatives from indigenous peoples’ organizations and international organizations. It’s not about policy or regulation, but strictly focused on collaboration. The second Ministerial focused on three themes:

- Strengthening, integrating and sustaining Arctic observations, facilitating access to Arctic data, and sharing Arctic research infrastructure
- Understanding regional and global dynamics of Arctic change
- Assessing vulnerability and building resilience of Arctic environments and societies

Dr. Petersen asked for additional information about the science that was discussed at the Ministerial, and Dr. Nikolaus reiterated the three themes, noting that the meeting was very broad. Dr. Petersen referenced a Washington Post article on NSF’s Multidisciplinary Drifting Observatory for the Study of Arctic Climate (MOSAIC) Expedition, and Dr. Nikolaus assured her that that topic would be addressed by an expert from NSF’s Office of Polar Programs who was coming to the AC-ISE meeting shortly.

Dr. Cohen encouraged NSF to engage more with the U.S. Coast Guard on this topic. He further indicated that some countries in Asia want an Arctic route to the United States and Europe, and therefore are happy to have all of the ice melt. Dr. Nikolaus indicated that it was not just NSF in attendance, noting that Tim Gallaudet from NOAA serves on the Arctic Research Commission and that there were other U.S. delegation members too. NOAA, NASA, Smithsonian, and also Coast Guard are part of a U.S. interagency Arctic research policy committee, she explained. Dr. Cohen spoke about icebreakers but learned that they were not a focus of the Ministerial.

NSF Convergence Accelerator

Douglas Maughan, Convergence Accelerator Office Head, Office of Integrated Activities

Dr. Avery welcomed Mr. Doug Maughan to talk about the new Convergence Accelerator initiative. Mr. Maughan began with a little background about himself: I am 10 weeks old at NSF, having arrived here on April 1 to launch the new Convergence Accelerator. His office is trying to push the envelope with respect to use-inspired research and to leverage all of the other work in research being done, but on an accelerated timeframe. This is not a traditional NSF basic research model, Mr. Maughan admitted. We are looking to be agile and support the work with the most innovative results for the nation. The idea is to take advantage of and use other testbeds and tools and things created in other places and do it on a larger scale than just a single PI or single, said Mr. Maughan.

We are specifically requiring partnerships with industry or nonprofits for state and local governments --the people who will be the consumers in the users of the technology, Mr. Maughan continued. Each of the projects is intended to have clear goals, milestones, and deliverables. On the management side, said Mr. Maughan, the idea is if you're at all from the entrepreneurial community and accelerator is really aimed at putting people together and then having them do not only cooperation but competition. We use very direct management styles, Mr. Maughan continues, with weekly communications and quarterly face-to-face meetings. We have three initial tracks that are based on the Big Ideas:

1. Track A - Harnessing the data revolution – knowledge networks like Siri. Use U.S. government and similar public datasets. Data security and privacy protection also important – how do you balance that with open, nonproprietary stage?
2. Track B1 - AI and the future of jobs – mechanisms that connect workers with jobs of the future.
3. Track B2 – approaches for employers to support workers seeking the skills required.

Mr. Maughan explained the progress since the Dear Colleagues Letter was released on March 15 and the ambitious plan for team formation and research plan development through March 2020 (phase I) and creating deliverables through May 2022 (phase 2). He and Dr. Lara Campbell also spoke of the innovative curriculum that the teams would be exposed to, and described the teachers brought in from outside of NSF, to answer a question from Dr. Avery. Dr. Yeh noted that intellectual property protection would be a very important issue, especially for tracks B1 and B2. Dr. Marzullo inquired about the makeup of the nonacademic stakeholders: Industry only or also nonprofits like library consortia? Mr. Maughan noted that it has been amazing to see the kinds of industrial partnerships that are on the teams, including large companies that have the capacity to take the results and get them out into the world more easily than tiny startups.

Mr. Maughan was also asked about whether there were international connections in the initial proposals. He indicated that so far, international universities have been engaged with the teams as well as one telecom group. There is more potential for international partnerships, he continued. He reflected on his prior government experience working at the Department of Homeland Security where he built 10 international partnerships with 10 countries and indicated that he had already met with three of those countries about the work of the Convergence Accelerator program.

Dr. Avery recommended also engaging with business schools at U.S. universities noting that their students and faculty would be experienced with pitching new ideas and could get the word

out about the Convergence Accelerator to their alumni networks. Dr. Cummings admitted that she was part of a team that submitted one of the original proposals and indicated that there was confusion about what was required. She suggested referring to Shark Tank explicitly as an example, though Mr. Maughan indicated that NSF could not actually use that copyrighted name in its solicitation materials.

Dr. Cohen praised the Convergence Accelerators program and indicated that it will help NSF explain the importance of research to the broader community because of its connection to increasing American influence, wealth, and jobs.

Supporting U.S. Participation in the International Multidisciplinary Drifting Observatory for the Study of Arctic Climate (MOSAiC) Expedition **Frank Rack, Arctic Research Support & Logistics Manager, GEO/OPP**

Dr. Frank Rack from the Office of Polar Programs joined the meeting to give a brief presentation on NSF's MOSAiC Expedition, the International Multidisciplinary Drifting Observatory for the Study of Arctic Climate Expedition. He described MOSAiC as multidisciplinary, with teams of scientists studying the atmosphere, the snow, the ice, the ocean, the system biochemical cycles and that's being done in the context of remote-sensing and air operations as well as very dynamic modeling programs. There are also project teams for data, logistics, education, outreach, and for media relationships, he indicated. MOSAiC is fundamentally the German icebreaker that will be driven up into the ice just off Russia. Then they will freeze themselves to that snow and draft for an entire year from September 2019 until September 2020. They will also instrument the ice about 30 kilometers around the ship with all sorts of scientific sensors and instruments and those will be collected data throughout the year, Dr. Rack continued. There will be five icebreakers providing support about every two months, so they will rendezvous, and 100 people will get off the ship in 100 will get on. Out of those hundred people about 45 will be scientists, he detailed, so you'll have about 270 scientists for the year about 600 people involved more than 60 institutions, 17 nations, and a lot of other assets combined for this program.

Dr. Wagner asked whether there was a place online to find updates, and Dr. Rack directed her to the MOSAiC website, funded by NSF in coordination with the University of Colorado. The U.S. German offices are also working together to provide media information including press releases throughout the year. Dr. Wagner also inquired about whether there was an ethics component to the research. Dr. Rack responded that the ethics are basically make observations and do no harm, and he expressed a willingness to speak further on the topic at another time. In response to inquiries about the key scientific questions and the itinerary, Dr. Rack indicated that the scientific questions are numerous and anything you can think of measuring, they will be measuring. The AC-ISE had more questions than there was time for answers, and the group agreed to include this topic as a standalone session for the next AC-ISE.

Input on Topics for Next Meeting

Dr. Avery confirmed the AC-ISE Members' interest in having a longer discussion on the international components of Arctic research at the next AC-ISE meeting, and then invited other Members to share ideas for future meeting topics. Dr. Wagner suggested open access and openness in general to include the benefits of lawful open access and data sharing and the

dangers of illegal sharing of scientific information (e.g., SciHub database of stolen scientific papers and data). The discussion could include how open access influences NSF at the international level, Dr. Wagner suggested.

Dr. Cummings noted that the topics for this meeting were heavy on the science and light on the technology side. Artificial intelligence and decision making is a global phenomenon which has broad implications to research as well as industry and would be a good topic for this committee to discuss. Second, suggested Dr. Cummings, let's discuss how to make global engagement a bigger part of NSF. For example, OISE could have more webinars and stakeholder engagement with students and researchers to put the office out there more. Dr. Avery reinforced that there has been a major change already in the last three or four years; a positive evolution. Dr. Cummings called it a messaging and branding issue. Dr. Robin suggested including a session with the Office of Legislative and Public Affairs on branding international in a more strategic way.

Dr. Islam recommended involving all of the Assistant Directors in the meeting and encouraging them to have line items in their budgets for international for example for engaging globally engaged citizenship in a partnership with OISE. Need to move toward having actionable outcomes from liaising with the research directorates. Dr. Avery recommended engaging with each Assistant Director individually. Dr. Robin thought that a session with all of the Assistant Directors could be effective if a specific topic was selected. Dr. Haynes reinforced the idea that one-on-one conversations with people lead to brainstorming that can lead to more productive ideas. If OISE can engage with individuals with ADs to align itself with the most strategic connections and partners. Dr. Howerton noted that Rebecca does meeting regularly with the ADs, and where the AC-ISE can help OISE is on how to prioritize and align our efforts and energy with what is impactful to the community. Dr. Wagner noted that other parts of the U.S. government like the White House Office of Science and Technology Policy and Departments of State and Commerce could be more active on the diplomatic activities so that NSF can be more focused on the science. Dr. Avery concluded that having one Assistant Director at a time would likely be the most fruitful at this time.

Dr. Avery suggested getting a National Science Board Member to speak with the AC-ISE about topics like creating a scientifically engaged global workforce. Dr. Cummings asked whether NSF can get more money for the additional representation that it is doing. From her experience on the Hill, Dr. Wagner suggested asking Congress for more funding in this way would not be successful.

Dr. Marzullo suggested three ideas for future meetings: more technology topics like smart cities or 5G; inviting speakers from NSF's Social, Behavioral, and Economic Science Directorate (SBE); and more on OISE's use of analytics.

Dr. Yeh recommended a follow-up session on science and security with time for input from the AC-ISE.

Dr. Islam asked questions about the role of AC-ISE and whether the Members can do more background work and talk with specific Assistant Directors in advance of the meeting. He went on to describe a book that defines four kinds of scientists: pure, arbiters, advocacy, and honest brokers. He recommended that the Members push NSF to create more honest broker scientists

who work toward actionable outcomes and societal impacts. Dr. Avery said that thinking in a systems way is important but noted that it is very hard to get a particular science division to think in a systems-oriented way. Dr. Wagner described her new book, *The Collaborate Era in Science: Taking a Systems Approach*, and offered to share it with the Members.

Dr. Haynes recommended OISE staff think through what questions they have for the AC-ISE Members, and perhaps send them in advance. She welcomed more understanding on Dr. Cordova's priorities and vision for international.

AC-ISE Recommendations Summary

- Dr. Islam suggested that science diplomacy efforts by different governmental and nongovernmental groups be combined.
- Dr. Islam recommended thinking about having concrete metrics at a practical / implementation level for international science engagement.
- Dr. Islam suggested that OISE link-up with a research directorate and identify a focus.
- Dr. Wagner suggested a summer program where students from three or four different countries get together to produce a video product.
- Dr. Yeh suggested partnering with scientific societies to amplify the impact of NSF dollars to create a globally engaged scientific workforce.
- Dr. Wagner recommended a statement or a manifesto of openness.
- Dr. Islam suggested that NSF may need to come up with a more nuanced definition of science.
- Dr. Petersen emphasized that U.S. federal agencies need to work together to address science and security issues.
- Dr. Islam recommended that each research directorate allocate a specific budget for international work. Dr. Islam recommended inviting the Assistant Directors to the next AC-ISE meeting to brainstorm for ways to add international components to all of their project budgets.
- AC-ISE Members suggested edits to the NSF criteria for international collaboration, as outlined in the session on strategic visioning.
- Dr. Marzullo suggested that the erosion of trust in public and private institution would be a key topic for conversation in the Global Research Council.
- Dr. Cohen encouraged NSF to engage more with the U.S. Coast Guard on Arctic research.
- Dr. Avery recommended the Convergence Accelerator program also engaging with business schools at U.S. universities.
- Dr. Cummings recommended clarifying the requirements and process for Convergence Accelerator applicants.