



Directorate for Mathematical and Physical Sciences (MPS) Advisory Committee
Meeting March 2021 (all times EDT)
National Science Foundation
2415 Eisenhower Ave, Alexandria, VA
Room E2020

Summary Minutes

Wednesday, March 10, 2021

Advisory Committee Members in Attendance (All Virtual):

Dr. David Awschalom	Dr. Robert Kirshner
Dr. Anna Balazs	Dr. Cornelia Lang
Dr. Susanne Brenner	Dr. Herbert Levine
Dr. Robert Bryant	Dr. Jennifer Lewis
Dr. Tabbetha Dobbins	Dr. Andrew Millis
Dr. Miguel Garcia-Garibay	Dr. Jill Pipher
Dr. Lynne Hillenbrand	Dr. William Tolman
Dr. Catherine Hunt	Dr. William Zajc

Call to order and official opening of meeting, FACA Briefing – Catherine Hunt, MPSAC Chair, Sean L. Jones, Assistant Director, MPS; Kathleen McCloud, Staff Associate, MPS

The meeting was opened at 12:00 pm by Dr. Catherine Hunt and began with a briefing from Dr. Kathleen McCloud on the policies of the Federal Advisory Committee Act regarding conflicts of interest for AC members, as well as a reminder that the meeting was open to the public and occurring under the guidelines of FACA. Dr. Catherine Hunt asked for introductions around the room. The minutes previous meeting, held in August 2020 and November 2020, were unanimously approved as presented by a motion introduced by Dr. Hunt.

Update: MPS – Sean L. Jones, Assistant Director, MPS

Dr. Sean L. Jones, Assistant Director for Mathematical and Physical Sciences, provided an update on the state of the MPS directorate.

Highlights:

Dr. Sean L. Jones, Assistant Director for Mathematical and Physical Sciences, provided an update on the state of the MPS directorate. Dr. Jones provided an agenda for the rest of the meeting. Dr. Jones highlighted staff changes within MPS including Dr. Tie Luo is officially Deputy Assistant Director and more Senior Staff positions will be filled in the near future. The budget for NSF in FY2021 had an omnibus bill for \$8.487 Billion, substantially more than the request and the bill included language for focusing on core research and facilities including QIS, AI, SII and more. Facilities construction on the Daniel K. Inouye Solar Telescope, Vera C. Rubin Observatory and HLLXC have had some setbacks due to COVID-19 as expected but there is still progress being made.

Touching on existing facilities, speaking at this point sharing updates on the Arecibo Observatory (NAIC), stating how it is a major focus of activity for AST, MPS, and GEO.

In the 2020/2021 appropriations act, congress required a report on the preliminary assessment of the collapse, clean-up and the path forward within 60 days. Sharing with AC members, that in the report we described the ongoing clean-up and forensics evaluations, the environmental litigation and historical preservation. As for the path forward, we are looking towards strong engagement in the community to identify the best ideas to meet



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the scientific needs of the future while recognizing the important role of the observatory that it will continue to play in the culture and development for Puerto Rico.

Additionally, we are planning an innovative and interactive workshop in a series of meeting spread over three months to develop the best community driven short-term, medium-term, and long-term ideas for the observatory and for the Island. Expressing the hope that the timing will be such that the results of the decadal survey can be incorporated, so we can understand how these proposed concepts mesh with the scientific priorities of the next decade.

Spoke of how in the last several AC member meetings of how we spend some time discussing NSF Director Sethuraman Panchanathan's vision specifically around accessibility and inclusivity which we have been referring to as the missing and invisible millions. Expressing to the members how we would like to give more context and information on the developing NSF priorities and the vision that has been laid out by Director Panchanathan. Representing the four pillars of the Directors vision, three themes advancing research and basic science, accessibility and inclusivity, global leadership recognizing that science as a global enterprise, and the fourth pillar translation, innovation and partnership which is foundational to all three mentioned themes.

Additionally, alongside Director Panchanathan vision are the focus pillars of the National Science Boards (NSB) vision 2030 document. Explaining that as you have been working on the strategic plan you have reviewed the NSB 2030 vision document which also outlined the four focus pillars. In the new Biden/Harris administration started their term off with four pillars of focus also, pandemic response, economic recovery, racial equity, and climate research. All of these were developed independently yet you can see that there is great synergy and alignment between these three visions.

Vision's discussion: Starting with advanced research and fundamental basic science there is a strong alignment with the NSB 2030 vision of obtaining the benefits of research, promoting geographic diversity and science participation, and promoting a strong global science and engineering community. Explaining that with the administration this NSF priority reinforces and addresses the pillars of responding to this current as well as future pandemics, recovery efforts for the economy and addressing climate change. When it comes to the NSF priority for accessibility and inclusivity, the notion that we need everyone engaged in the same enterprise, aligns with the NSB 2030 vision of growing and supporting diversity and talent from all across the country. In this NSF priority is in strong alignment with the administrations pillar on racial equity, but it also essential to address the economic recovery pillar as well. Emphasizing that we need everyone engaged in this recovery. Recognizing that science is a global enterprise, knowing no borders and that the agency seeks to maintain the US leadership in science. The NSF priority area of global leadership aligns with the NSB 2030 vision pillar promoting a global science and engineering community. Stating further how this global leadership program supports and is in alignment with three of the administration pillars as well, again all world approach is essential to addressing many of these grand challenges that we have before us.

The fourth NSF priority area, translation, innovation, and partnership which is a foundational pillar integrated within the three of the other NSF priority areas, is an essential element for how NSF aligns with all of the focus areas of the NSB 2030 vision document. It is vital in addressing and supporting all four pillars of the administration.

Expressed thoughts of the alignment being timely with our discussion today on the AC's recommendations for the NSF strategic plan. Expressed that we are looking forward to hearing more from AC members on this today and its continuation on Friday.



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Shared how the director (Sethuraman Panchanathan) recently gave a much more in-depth review of his vision and the NSF priorities on the first day of 471st meeting of the National Science Board (NSB) this February. Expressed to the AC members that it is time to review the Directors discussion for a more comprehensive view of translation, innovation, and partnerships, as well as the three NSF priority theme areas.

Shared with the members that the Directors discussion could be found by doing a google search on 471st Meeting of The National Science Board and or perform this search in YouTube.

Expressed that we would like to keep giving updates on the agency's response to COVID-19 and hope it will also inform our listening session later today. Last year, a response to the pandemic NSF did two several things. NSF increased flexibilities for continuing grants, and proposal submission deadlines. NSF also created new programs and expanded some. The Cares Act Rapids is an example of one of the new programs created.

The question has been, "What's Next"? How will the agency continue to respond to this pandemic? The agency has been actively listening to the community and trying to develop more data driven responses and approaches in talking with the professional societies, COVs, and ACs. We heard a rather consistent message which was that NSF should focus on the most negatively impacted groups as well as those that have vulnerable transition points in their career and with limited resources NSF should prioritize the response based on these two points and scale them accordingly.

Asking, so who are the most impacted that we heard from these listening sessions? These groups and individuals fall essentially into this list of vulnerable transition periods or points. Those most vulnerable are at transitions in their careers. We heard from many that there is a significant fear in the community that we may be losing a generation of young scientist, and we should put priorities here.

So, how will we prioritize and respond to the information that is received to date? Again, by looking at the most vulnerable populations that have been identified. NSF has a potential wave of investments in these categories, focusing again on those launching into their careers at this most fragile transition points. NSF mechanism tends to fund multiple categories, so there may be opportunities to scale across vulnerable groups depending on the mechanisms as well. This is NSF thinking based on the feedback we have received to date.

Questions:

- AC: [Robert Kirshner](#):
 - I was interested in one point about Arecibo, which was the idea of incorporating information from the decadal report into your response. Also, I was wondering, time only goes forward in the decadal report had most of its input before the problems in Puerto Rico. So, I was wondering if you could say a little more about that?
- MPS: [Sean L. Jones](#):
 - The decadal will not only give recommendations on facilities and infrastructure, but also on science area priorities. We are hoping that will actually outline and inform the community involvement and ideas that they are going to generate for short, medium and long-term. We really want the observatory to lean forward into the future and align itself with the decadal science priority, so the hope is that this will be a strong and positive outcome from the convening as well as taken again incorporating what has come out of the decadal studies.
- AC: [Tabbatha Dobbins](#):



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- I have a question regarding the pandemic responses. The world will change post pandemic, and many institutions are already gearing up for that kind of permanent change to the way that we do things. How is NSF preparing for these types of anticipated permanent changes which will outlast the precautionary things that we are doing during the pandemic?
- **MPS: Sean L. Jones:**
 - As an agency and the federal enterprise, as an entity itself we are also taking that question into account as it relates to how we will operate and how will we work with the community going forward. We have several groups, for example the COVID-19 response team that looks externally. Internally, we have a working group that is pondering these kinds of questions. We do recognize that the world was forever changed by how we have responded to the pandemic. We will be moving forward with changes in the agency and how we interact with the community as well. This is part of what we are listening to, as we talk about how we mitigate some of the issues with COVID-19, we will also hear from the community new ways of interacting with the community. Before we were very heavy on in person panels, now that we have trained for over a year on how to do Zoom and electronic meetings, maybe we will take this as an opportunity to be able to incorporate more diversity in our panels through a much more hybrid approach or maybe all virtual panels. We are talking about different ways of interacting and working with the community as well.
 - Expressed to Tabbetha that incorporating this into your feedback whether it is this AC meeting or other AC engagements is always welcome.
- **AC: Herbert Levine:**
 - I have a related question but focusing more on the very good job the NSF did with the “Research Advanced by Interdisciplinary Science and Engineering” (RAISE) program funding research initiatives related to COVID-19. Is this going to continue? Is it going to morph into something more permanent in terms of looking at infectious diseases as a more strategic initiative for the NSF not necessarily for MPS but more generally?
- **MPS: Sean L. Jones:**
 - We can’t discuss pre-decisional activities, but you could imagine that because we are so aligned with the Biden administrations four pillars, that NSF would be moving forward with research that would be proactive in this area. Once our current plan is approved, you will be hearing a lot more about NSF’s specific responses to the pandemic and to the COVID-19 situation.
- **AC: Catherine Hunt:**
 - Question around accessibility. I think it is great that we have gotten more comfortable with using Zoom, but then there are still people who can’t get on the internet and so they can’t even get into it as part of Zoom, and so perhaps this is more related to the IT meeting that you are going to next, but do you see where MPS is involved in that accessibility avenue?
- **MPS: Sean L. Jones:**
 - This is certainly a nationwide issue beyond just NSF. The Department of Education is extremely interested in this type of leveling the playing field and having accessibility to everyone in the nation. This is on the radar of the foundation of programs and ways to help mitigate that, but this is something that is going to have to be done in partnership with our federal agencies for a nationwide approach for accessibility, for example broadband, and rural access and things like that.



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Industries of the Future: Biotechnology –Theresa Good, Deputy Division Director, BIO/MCB and David Berkowitz, Division Director, MPS/CHE

Dr. Catherine Hunt introduced Dr. Theresa Good and Dr. David Berkowitz. Prior to discussion, Dr. Hunt informed the AC members that there is a new FAQ sheet from NSF on Biotechnology leadership which Dr. Hunt used as a lead into the discussion.

Here, Theresa provides an overview to the AC members expressing that today, she and David will discuss Industry of the Future Biotechnology.

- NSF's investments in Biotechnology innovation, and Bioeconomy research.
- The Big Picture that we are going to try to convey, is that NSF has a long history of investing in interdisciplinary research in this space. Funding discoveries and innovations that have all had an impact on the Bioeconomy and that with more investment and more coordination we will only increase the impact of what NSF does in this space.

So, what do I mean by Biotechnology innovation and Bioeconomy research?

Theresa spoke of the definition that appears in a slide on the screen being provided to “us” by the Office of Management and Budget and OSTP. Expressing how the definition comprises many things from research to infrastructure to workforce.

What we invest in at NSF is part of a larger context at the national level. We are coordinated through a number of committees and subcommittees at the Nation Science and Technology Counsel, through the National Security Council on through the committee of science at OSTP where NSF either chairs or is a member of all of these subcommittees. It is coordinated at the community level through funding of activities like the Engineering Biology Research Consortium (EBRC), that develops roadmaps in many different sectors of the Bioeconomy. Expressing how it is guided in some parts by pending legislation and executive actions including the Bioeconomy Research and Development Act where NSF plays a leading role in such actions in basic research, enabling technologies, workforce development, biological data, and the measurement of the bioeconomy through the National Center for Science and Engineering Statistics (NCSES) at NSF.

Expressed how NSF has had a long history in funding discoveries that have led to innovations. Giving the example of the work that we funded back in the 60s where he was doing some research on life and extreme environments and discovered some unique enzymes in thermophilic bacteria that led to the innovations in PCR (Polymerase Chain Reaction) that are a cornerstone of all the PCR COVID that we see today.

Through investments has allowed training people like Julius Lucks a Chemical Physicist out of Harvard who has developed the first paper-based test for COVID similar to a paper-based pregnancy test.

Additionally, speaking how investments have led to the advancements in genomics and sequencing that have been used by mathematicians and statisticians all over the world to predict and track the spread of the COVID-19 virus.

Used this time to speak of Nobel Prize recipients (most in Chemistry) over the last decade or so and how some of them were PI's funded by NSF throughout their careers.

At this point in the discussion, Theresa offers the members an educational example. One of the things that NSF funds through the education and human resources development, is through the advances and



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technological education program. One of the projects is InnovATEBIO. This is a program that supports development of community college programs across biotechnology in the country. There are more than 100 community college programs and an equivalent number of K-12 programs involved. The program develops and disseminates materials for community college educators. It connects programs and students to over 750 employers across the biotechnology industry. It helps to ensure that the U.S. has a diverse trained workforce to meet the needs of the U.S. Bioeconomy industries.

Emphasized the virtuous cycle between discovery and innovation is part of the magic of NSF.

When we talk about the biotechnology, innovation, and translation their impacts are far beyond environment. Expressed that economics is not the only thing that we are translating, but the environment, public health, and social justice are also ways that we have impact and where we have translated the results of our research to benefit society.

Here, Theresa gives AC members examples of core research programs that fund basic research, workforce, and use inspired research in Biotechnology innovation.

MPS

- Mathematical Biology Program
- Chemistry of Life Processes (CLP).
- Physics of Living Systems (PoLS).
- Biomaterials Program (BMAT).

Shared with AC members the new program in Chemistry called, the Molecular Foundations for Biotechnology (MFB). Programs at the Center level that support biotechnology innovation such as some of the Physics Frontier Centers or the Math Institutes.

At the Workforce level we fund things all the way from K - 12, to graduate, and postdoctoral levels.

At Infrastructure, there is a broad range of investments, many of the facilities you will hear from Dave that are funded through MPS.

Spectrum of things that fall somewhere between basic research use inspired translation. Programs like designing materials to revolutionize and engineer the future or designing cells beyond the bounds of evolution, or future manufacturing.

Program to be funded out of Montana where that are using biomineralization to build recyclable building or construction materials which might be able to be used in a disaster setting.

About a 1 to 7 match between what NSF funds and what these industry's fund in these centers. About 25% of what is in the portfolio is in the biotechnologies space.

NSF has investments in biotechnology at the center scale really almost in every state in the country and if infrastructure were included, we would hit Florida. If you want additional details on those investments, David or I would be happy to provide them.

The kinds of messaging we are getting from the National Science Board and NSF leadership. Some of the ideas of what the future might look like come industry of the future institutes. Public and private partnerships should be leveraged. Address grand challenges and solve big societal problems.



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MPS: [Dr. David Berkowitz, Division Director, MPS/CHE:](#)

We are thinking a little differently, taking our lead from the Director Panchanathan and his new assistance, Erwin Gianchandani, who spoke recently at the NSB meeting about innovation accelerators. Both speak very often about inspired fundamental research. This is a theme of what we are talking about today.

Depicted via slide a map of the United States specifically focused on MPS. The slide shows “Center” level investments that are in biotechnologies. Notice on the right, there are for example three Physics Frontier Centers (PFC). We focused on one of the Centers for Chemical Innovation (CCI) from Chemistry that is in California Berkley. There are six of these in phase II. This is the one that is most aligned with Biotechnology.

Additionally, there are four Math/Bio Institutes, there is a MRSEC featured that has biotechnology themes from DMR, but there are also Material Innovation Platforms (MIP), two of these from DMR that have Biotechnology themes.

CCI, is a two phased program. Designed to have teams of scientist address grand challenges related to chemistry. Focusing on the Chem/Bio interface. Phase I, investment is about 1.8 Million dollars, or typically about three collaborative investigators. Phases I’s complete for the 20 Million dollars over five-year investment that is typical of a Phase II.

Showing a slide depicting all of the Phase II’s (20 million dollars). There are eight Phase II’s, 2 of the eight are sunseting. The other six are full-fledged 20-Million-dollar investments.

C-GEM – Center for Genetically Encoded Materials led by Alanna Schepartz at UC Berkeley.

“High risk, high payoff” investments, the team is looking at the ribosomes, looking at biology, and seeking to co-op biology to make polymers that are quite different from proteins. You could call it green polymer factory if it would work as designed. The group has succeeded in co-opting the ribosomes to make.

Facility or Infrastructure investments in Chemistry in addition to the Centers for Chemical Innovation (CCI), these tend to be equipment-based facilities. In two cases, MMLI (Molecule Maker Lab Institute) brand new investment in AI Institute these are spearheaded by CISE. This is one in which Chemistry has taken the lead in partnership with C-GEM and DMR. This one is at the University of Illinois Urbana-Champaign. It is in its first year. It’s a software institute but not your typical software institute. It is really the combination of synthesis and artificial intelligence.

Nexus is the first mid-scale investment for Chemistry. It is being built now at Ohio State. It will provide an extreme ultra-fast science source for our community.

Molecular Foundations for Biotechnology initiative in Chemistry. This is a brand-new initiative for which the letters of intent have come in and the full proposals will come in in about five days. There has been a great response from the community. We envision a multi-year campaign. This is really use inspired fundamental science. It is based on the fundamental principles of synthetic physical organic chemistry and molecular recognition. Activity based protein profiling.



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Highlighting Center level investments from Physics. These are also highly collaborative in the Physics Frontier Centers referred to on the map. Physics partners with Chemistry, DMR, MCV, and IOS to fund these.

- The Center for Theoretical Biological Physics Headquartered at Rice University leads in theory.
- The Center for Living Cells at the University of Illinois Urbana-Champaign, that looks at complex living systems.
- The Center for Physics and Biological Functions Headquartered at Princeton,

Ends the discussion showing slides with animation on “Problems of Condensation in the Cell and Phased Transitions”. Shows the example of Clifford Brangwynne at Princeton explaining how it was from a career award in the Physics of Living Systems (PoLS) Program.

AC: [Dr. Jennifer Lewis \(AC Liaison\)](#):

Wonderful to have this opportunity to describe a subcommittee that I serve on, MPS and the Living World. The charge of the subcommittee is really to build strategic collaborations across MPS and beyond. Update on the activities that this subcommittee has been undertaking, including our goals, the team members, and an update on where we are at. The goals of the subcommittee are to harness the full capabilities of the MPS to enable the future of biotechnology.

Idea is how do we take across of divisions within MPS and really how do we strategically link beyond that to the Engineering Directorate, the Bio Directorate, to ensure that the U.S. will remain competitive in biotechnology. Spoke of how Biotechnology is having an increasingly broader role across many industries.

At this point in the discussion, Jennifer introduces the leadership. Spoke of the kick-off meeting on January 15th. Words used to describe the kick-off meeting were productive, energized. Expressed that during the kick-off meeting we coalesced around four key topics Emerging Theories, Tools, Critical Problems and Applications, and the Human-Biotechnology Interface.

Spoke of keying in on critical problems in applications because that also drives investment. Where are the really big opportunities in biotechnology? What is the next big thing, like we think about single cell sequencing? What is on the near horizon? What is on the horizon beyond that?

Finally, the human biotech interface. Each of these topics has membership from the leadership of the committee or the MPS AC.

Questions/Answers:

- AC: [Cornelia Lang](#):
 - Wanted to express that she is thrilled when she hears these presentations from NSF about cross cutting themes and thinks that it is remarkable. In particular, I think very deeply about these themes for the sort of workforce development at the undergraduate curriculum level. Wearing my University Administrator hat here for a moment, I wonder to what extent these incredible cross cutting themes are actually flowing over into the NSF Education Directorate? So, I think about the NSF’s IUSE program it is one that is near and dear to my heart. I just think it’s just fantastic work on how we can do better in undergraduate education and bringing more folks into the STEM



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- workforce. I just wonder if these themes have kind of rolled out into some of the opportunities that come through investigators who want to propose through that Directorate.
- MPS: [Theresa Good](#):
 - Sure, there are a large number of investments in the EHR investment. Whether it is at the Community College level or the undergraduate level or at the graduate level that cover education. In these interdisciplinary programs education sits at every one of those steering committees and education is part of the piece that goes when we give input at the federal legislation it is always about talent and if at any of those center programs workforce development talent and diverse workforce is always a key of those. It is important and the voices from the EHR Directorate are strong in every one of those coordinating committees.
 - MPS: [David Berkowitz](#):
 - The PREM Program in DMR connects the MRSEC with institute minority serving institutions directly. These are large investments in addition to MRSEC which sets up those partnerships which would be one example in MPS that again is sort of a banner example. I believe it was pioneered by our AD when he was in the trenches, so he could say the most about it, but it is really remarkable when you look at the statistics of what has been done there to broaden participation and inspire those from HBCUs and HSIs for example to take on PhD studies in areas related to these branches.
 - AC: [Cornelia Lang](#):
 - Thanks so much, I just think about courses even at the basic introductory level that rather than being siloed in their disciplines are offered as a course around a theme and it just makes me so excited. So, thanks for all the great examples, and thanks for answering the question.
 - AC: [Herbert Levine](#):
 - I think the effort is really exciting in the sense that I think Theresa and David outlined all the incredible variety of things going on at the NSF. The variety is almost overwhelming and, so for me the real challenge is each of those individual pieces is going to be generating new ideas, new theories, new technology. This has to somehow bubble-up into a great new direction from thinking about it from the technology end. I think this is one of the things that the subcommittee will figure out, how exactly this is going to happen at least at the MPS level. There are so many pieces that probably just keeping track of all the individual pieces is hard enough. The real homerun is when all those pieces somehow congeal together to come up with a great new direction, so I am really looking forward to sort of seeing how that might be working at the MPS level.
 - MPS: [David Berkowitz](#):
 - The slide that Theresa showed on Innovation Accelerators is very much inspired by our leadership by Panchanathan and Erwin who have articulated a vision similar to what you just stated. I think within MPS as you know we can build on when astronomers collaborate with physicist and chemist and material scientist to think about what we call “Windows on the Cell”, looking at the cell with completely new optics, new technology. It is very important that we also collaborate with biologist and the computer scientist in building out these innovation accelerators, but we have it under one roof at NSF which is to me also the excitement here.
 - AC: [Herbert Levine](#):
 - That sounds great, I am looking forward to learning even more about the pieces that I am less personally familiar with.
 - AC: [Catherine Hunt](#):



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- Maybe I can even pile onto that, thank you Herbert. The NSF FAQ Sheet that was just published yesterday.
- MPS: [Theresa Good](#):
 - The bioeconomy coordinated committee that David and I serve on was compiling the information to put that together. It highlights the breath of the investments and gives some sense of the amount of money that NSF spends in this space.
- MPS: [David Berkowitz](#):
 - There was a question again about Astronomy. One of the things that I didn't mention, I talked about the center of eco evolution which those \$20 Million CCI phase two's are sunseting because it has had its 2nd \$20 Million increment but that was a partnership with the NASA Astrobiology Program so that is another way of leveraging expertise in astronomy in house and with other agencies and Mary Voytek in the astrobiology program was really our liaison there. . We also want to think about partnering with other agencies and private foundations the Simons is great example of partnering.
- AC: [Robert Kirshner](#):
 - I was very interested to see this incredible span of work. There was one aspect of it that we have been looking into and then I kind of wanted to learn a little bit more about. Which is, you talk about sustainable polymers, and you talked about making ribosomes, and somehow getting out of our dependence on petrochemicals. I wonder if you could say a little more about what is going on at NSF in this area or related one on green chemistry, or being able to make a real circular use of materials in the world?
- MPS: [Theresa Good](#):
 - NSF has funded over a number of years different petro scale investments so the center for bio-renewable chemicals has an engineering research center that just recently ended the center for synthetic biology's, both of these were in that space. I think the center for cellular construction also is kind of in that space. Also, through future manufacturing, there are a number of these kind of large, big team awards that were in the space of really not just bio renewable chemicals or bio enabled production, but in recyclable circular bioeconomy space. In terms of center scales, that probably captures it, and then through the portfolios in engineering in the biochemical and cellular engineering program through biology and the systems in the biology program in chemistry, probably through the Chemistry of Life Processes (CLP) Program. There are individual investments in this space, and so I think there is this combination of center scale, really big teams and some of the things that came out of NSF 2026 is that some of them were in that space, and I think as we address administration priorities of climate change, I would not be surprised about what happens next.
- MPS: [David Berkowitz](#):

Bob, in terms of starting with lignocellulose, it's probably going to start in engineering, but it could be green in other ways. If it is going to use enzymes as catalyst then the AI Institute that I mentioned is a beautiful example of a piece of biocatalysts, they are partnering with traditional synthetic organic chemist and they are trying to interface with catalysis to develop greener chemistry to perhaps inspire process groups like the MERC process group who is really revolutionizing the way we think about process chemistry by using enzymes instead of traditional organic reaction and involving those enzymes. I am really excited about what the AI Institute is doing in that space, a little more traditional chemical, but perhaps not as green but circular would be to two other CCI's that I showed but did not talk about. The center for



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sustainable polymers at the University of Minnesota is going beautiful work in recyclable and upcycle polymers and that is a huge investment it is not enzymatic but is green in the sense that its circular or it is heading towards circularity. The center for sustainable nanotechnology whose Headquarters is at the University of Wisconsin is similar but focused on nanomaterials than making them more sustainable.

- MPS: [Linda Sapochak](#):
 - Sean was a lead Program Director for PREM (Partnerships for Research and Education in Materials) for many years and helped to shape the program. PREM was developed back in 2004. Originally, the idea was to promote cooperation between minority serving institutions with our Centers Program, our MRSEC (Materials Research Science and Engineering Centers) program, which is actually a Centers Program, not quite an infrastructure, similar to CCI as it does have innovation too. We have expanded it to now include our facilities and DMR also supports scientist technology centers. The idea is for a place like a MRSEC that has a lot of capabilities, and people that know how to work with MSIs who are at different stages in their ability to do research. Some of them are just starting and have never done research, some of them have active research programs, but it gives them the ability to identify how they can feed into that very complicated pathway that undergraduate minority students kind of go through. They don't just go linear like we think, you know like graduate school. They do all kinds of other things, but for them to really look at that pathway then use education and research as a way to build up, a way to help them navigate through those strange pathways. It has been very effective; we have lots of PREM and former PREM students that have become professors who have gone into industry and all kinds of things.
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- MPS: [Linda Sapochak](#):
 - I just want to edit to Bob, to note that David showed you our materials innovation platform at UCLA and UC Santa Barbara. The focus there is on sustainable development of polymers. They are really talking about the cycle structure. David kind of alluded to that, but that is their main goal. They want to be able to develop the supply from using synthetic biology and then going through that whole cycle of things. I just wanted to re-emphasize that.

NSF Strategic Plan: Thoughts from the AC —

Steve Meacham at NSF Office of Integrative Activities (presentation)

Goal: Provide some context on the development of the strategic plan, show how the plans translate our mission into goals and objectives, drive NSF execution of its mission, and to give an update on our progress thus far.

Strategic Plan is an opportunity for NSF to set goals and objectives that reflect the context, challenges, and opportunities for research over the next 5 to 10 years. NSB Vision 2030 document has underlined what the strategic plan needs to capture. Key part of the context that informs the strategic plan are those priorities such as:

- Enhancing public health
- Economic recovery
- Technological leadership
- Racial and gender, equity
- Climate change



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Key strategies that have been identified to enhance the benefits to society:

- Emphasizing the synergy between exploratory research and translation to impact
- Growing partnerships
- Fostering innovation

NSF strategic plan lays out the broad long-term outcomes the agency aspires to achieve as we implement our mission. NSF strategic plan is intended to facilitate a response to challenges and new opportunities as they arise.

Each strategic objective has a narrative of elements that indicate areas of emphasis that we think are needed to make progress on that objective. Some are linked to more than one objective. We have been collecting input from other stakeholders, NSF Advisory Committee, professional societies, and individual researchers.

Andrew Millis

Quoted directly from document - it is a time to revitalize the contact between the nation and the scientific community and to transform the support for science and technology. It's also a time of unprecedented threats about the development of competition and economic. The basic scientific infrastructure is at risk with the current funding, unable to sustain the basic research environment at universities, and we strongly believe the 2022 to 27 strategic plan should address these issues directly.

Challenges: current system is under high and increasing stress, grants are insufficient to sustain research and tension between the needs of infrastructure equipment centers, individual PIs, STEM workforce. NSF has a stewardship responsibility for the science enterprise and the strategic plan should reflect this. MPS Advisory Committee, very strongly believes business as usual is not a viable approach. Basic research is critical to delivering technology driven innovation and questions arising from technology are stimulators of basic research. NSF could create an infrastructure and tools that will enable American scientists to deliver the required foundational science insights information and results.

MPS should not take on responsibility for technology development and instead focus on expanding its portfolio of basic research, while developing effective modes of partnership and collaboration with mission-oriented units in the NSF. NSF and MPS should engage, train, and cultivate a diverse talent pipeline with the brightest undergraduate, graduate and postdoctoral students to develop leading edge entrepreneurs, educators, employees, citizens, and scientists.

Business as usual is not the way to go and we have to change how we do business. The second issue is the relations between basic research and technology development and applied research. Third issue is everything around equality, diversity and areas of workforce development. Now open for discussion.

Jill Pipher

Possibility of funding, a new Directorate in NSF. This new directorate would expand the mission and goals of NSF, fund support research and technology. The research infrastructure and workforce for basic science research by NSF estimates the funding source for approximately 27% of the total federal budget for basic research in universities. I have pointed people with concerns to the provisions of the endless frontier bill that discusses a one-way flow of money and provisions to hold harmless the appropriations to other directorates.

The technology focus areas are critical and really require the basic research that is supported by MPS. A strong link between advancing basic and translational support could be reinforced by adding this Directorate to NSF. The new Directorate would offer support of fundamental science, workforce support, and strengthen its



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domestic workforce in math and physical sciences. I think the technology focus areas are critical and require the basic research that is supported by MPS and could be reinforced by adding this Directorate to NSF.

Jennifer Lewis

The opportunity would be to have the partnerships between that directorate and the existing directorates that are more fundamental, and science related to keep a pipeline through basic research and resources that would really help the nation.

Robert Brown

Agree with Jill and Jennifer. The real challenge is helping the public in understanding. To have a new division is public outreach to help people understand the close connection. It's probably easier to see how fundamental research can support and drive technological innovation. It's important that we find ways to strengthen the basic research enterprise and making better connections with technological innovation. We have a lot of young people, very talented young people finding it difficult to find a place in the system.

Lynne Hillenbrand

The question should be at the expense of what, unless there is a large influx of money from Congress to support it. The other point is you know we had a discussion on DMR and the recommendations that we heard of COV. We should revisit some of the principles that we had raised during that discussion.

Tabbatha Dobbins

There has been an erosion in the trust in science and findings by the public. Specifically in under-represented populations, public institutions or even medical institutions such as the Tuskegee experiment. The question is what role can NSF play, ensuring that the public understands and trust science? Second, can the mistrust that's out there be used to influence and drive more students from underrepresented groups into the sciences?

Steve Meacham

We can show positive benefits that helps increase trust. There has been social science studies that demonstrate trust and innovation in science have increased during the pandemic.

The US and world responding rapidly to this pandemic to generate vaccines within less than a year is an achievement. If you could highlight other examples, we could use that to try to increase public confidence.

Robert Kirshner

An important thing to do is to show people the benefits of research first then the application to the economy or climate. There has to be that understanding comes first and that we can find ways to having benefits for society to scientists and to the people who write the goals for the administration.

Steve Meacham

NSB is a very strong supporter of NSF investing in science. Advancing the frontiers of research and the NSF mission statement is promoting the progress of science. Congress has always been there to provide funding to support basic research funded through NSF.

Bill Zajc

Will you be advocating for the changes in the org chart? Is the hope that will lead to the agency addressing the problem that the advisory committee has identified the strain on existing resources?

Steve Meacham



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We don't set separate goals and objectives. Focus on what's important about pushing the frontiers across all areas of research and increased knowledge has the fact that we need to increase the literacy of the general public.

Catherine Hunt

What is it you want to get done and how do you write that into your strategy to make the space for it moving forward? What I don't want us to do is to feel the strain of the budget dollars to keep us from putting out a strategic plan that addresses what we want to address.

Steve Meacham

The size of the budget is not really an influence on what objectives to achieve. We look to the objectives to come from the nature of science and the context in which we operate these challenges that come from society.

Catherine Hunt

This topic to continue Friday.

Discussion of MPSAC Facilities Subcommittee– Robert “Chris” Smith, Senior Facilities Advisor, MPS/OAD and Sean L. Jones, Assistant Director, MPS

COVID-19 Impacts – NSF Communities Perspectives

3:15 – 3:35 PM Presentation by Cornelia Lang, University of Iowa & Miguel Garcia-Garibay, UCLA
Cornelia Lang and Miguel Garcia-Garibay provide a PowerPoint presentation after a brief introduction.

Introduction:

- COVID Impact on universities and labs for the past year summarized. Even now only about 25% of classes and labs meeting in-person. Overall impact of COVID has been tremendous at many levels.
- One area not often mentioned for impact is hospitality services provided by universities. Many other support services also highly impacted.
- Programs quickly utilized to provide needed technology to low-income students to facilitate remote learning.

MPSAC Community Feedback on COVID Impact:

Key point – The need for flexibility and support for people.

Most pressing concerns summarized as item 1-7 on slide 5 of presentation:

- e.g. research facility closures or reduced activity. Slowing of graduate student matriculation. Undergraduate students missing hands-on experience.

Strategies Undertaken to address items 1-7 above summarized in slide 6 of presentation.

- e.g. outreach efforts to investigators increased, extension of timescales...

Suggestions for NSF summarized on slide 7 of presentation.

1. Funding flexibility and flexible programming
2. Significant additional support for undergraduate and graduate students.
3. Consider a new postdoctoral fellowship program.

Key development: Increased energy around social justice in STEM.

Lynne Hillebrand: There could be more organized support for the coordinators of virtual conferences, or for mentoring programs, as virtual conference and program attendance is much larger than in-person attendance.



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Catherine Hunt: mentions that a particular 2-day virtual conference was opened up for students to attend virtually for free. “We need to rethink how people are attending conferences.”

Sylvia James: The presentation aligns with the direction NSF is taking to address challenges faced by the field due to COVID. Recommendations included in the presentation are certainly ones that can be considered by NSF and are very helpful.

Robert Kirshner: Mentions the challenge of home childcare related to COVID impact. Points out that this is where there is a lot of pressure particularly for younger faculty members.

Robert Bryant: Agrees that reliable access to childcare is a key area to address. Also comments that the interactions at virtual conferences are not as in depth as an in-person attendance.

Miguel Garcia-Garibay: Emphasizes that the rate of matriculation is slowed as an impact of COVID.

Sean Jones: Thanks the presenters and the participants for their thoughts and suggestions.

Preparation for Meeting with NSF Director and Chief Operating Officer

AC members continued discussions from earlier in the day and organized their main positive points and questions for the director.

Closing remarks and adjourning for the day

Dr. Hunt thanked the AC members, NSF Staffers and everyone for joining the meeting. She adjourned the meeting at 5:00 pm for the day.

Friday, March 12, 2021

Advisory Committee Members in Attendance (All Virtual):

Dr. David Awschalom	Dr. Robert Kirshner
Dr. Anna Balazs	Dr. Cornelia Lang
Dr. Susanne Brenner	Dr. Herbert Levine
Dr. Robert Bryant	Dr. Jennifer Lewis
Dr. Tabbetha Dobbins	Dr. Andrew Millis
Dr. Miguel Garcia-Garibay	Dr. Jill Pipher
Dr. Lynne Hillenbrand	Dr. William Tolman
Dr. Catherine Hunt	Dr. William Zajc

Call to Order, FACA Briefing, and Official Opening of the Second Day

The meeting was opened at 12:30pm by Dr. Catherine Hunt and began with a reminder from Dr. Kathleen McCloud on the policies of the Federal Advisory Committee Act from the previous day’s briefing.

Industries of the Future: Advanced Wireless/Spectrum—Ashley Vanderley, Program Officer, MPS/AST and Thyagarajan Nandagopal, Deputy Division Director, CISE

- Our communication systems have rapidly changed



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- Regarding the spectrum:
 - It
 - Is the entire electromagnetic spectrum
 - Connects to astronomy, mathematics, and physics
 - Its challenges include
 - Commercial
 - Public Safety
 - National Security
 - Science
 - The Electromagnetic Spectrum Management (ESM) Coordination Group's Spectrum Innovation Initiative (SII) has
 - Goals to innovate and secure
 - These four parts:
 - National Radio Dynamic Zone
 - National Center for Wireless Spectrum Research (SII-Center), which requires an interdisciplinary skill set
 - Spectrum Research Integrative Activities
 - Education and Workforce Development
- Advanced Wireless Research (5G and beyond)'s
 - Benefits include affordable and equitable high-speed broadband
 - Building blocks are
 - Electromagnetic spectrum expansion
 - Increased spectrum efficiency (higher data-speeds/Hz)
 - Switch from hardware-heavy to software-heavy network
- Multi-Directorate Spectrum R&D Programs are
 - Spectrum and Wireless Innovation enabled by Future Technologies (SWIFT)
 - Machine Learning for Wireless Networking Systems (MLWiNS)
 - Spectrum Efficiency, Energy Efficiency, and Security (SpecEES)
 - Enhancing Access to the Radio Spectrum (EARS)
- How are we engaged across the U.S.?
 - MPS: Collaboration with the National Aeronautics and Space Administration (NASA) and Lead-Agency Agreements with other countries
- What measures are being taken to prevent space weather-related issues?
 - MPS: There is a Space Weather Action Plan
- What are the Broadening Participation touch points and timeline?
 - MPS:
 - Challenges for the workforce include
 - Finding qualified people
 - The digital divide
 - The timeline is one to two years
- Please clarify the privacy and security aspects.
 - MPS: Our Secure and Trustworthy Cyberspace (SaTC) program is for this
- How does Research Experiences for Undergraduates (REU) apply to this?

MPS: We ensure that the appropriate training and exposure to these types of careers is provided



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Industries of the Future: Advanced Manufacturing— Dawn Tilbury, Assistant Director, ENG and Linda Sapochak, Division Director, MPS/DMR

Dawn Tilbury and Linda Sapochak provide a PowerPoint presentation after a brief introduction. Dawn Tilbury begins presentation with an overview of the manufacturing process, benefits, and Advanced Manufacturing processes.

The following slides were reviewed.

- Industries of the Future
 - Automated manufacturing is one of the five industries of the future put forward by the administration and enforced by congress.
- Advanced Manufacturing
 - New ways to manufacture.
 - With high performance computing and high-speed networking the entire factory can be connected through the company and up and down the supply chain.
 - One of the biggest challenges faced today is how to leverage all the data.
 - Manufacturing new products – new materials and emerging capabilities of those materials
 - A lot of work is going on in this area in MPS/DMR
- 16 Manufacturing USA Institutes
 - Public/private partnerships that are funded by the federal government in partnership with industry.
 - Transitions results of research into production at manufacturing plants.
 - NSF does not fund Manufacturing Institutes.
 - NSF has liaisons, Program Officers, at each institute to keep a pulse on what is happening in the institute and industry.
 - NSF funds projects that use the equipment and resources at the Manufacturing USA Institutes
 - NSF partnerships to transition research. For example, the transition of research through manufacturing institute to an industry partner.
 - Workforce development in manufacturing industry is primary focus of all institutes.
- Recent and Upcoming Workshops
 - Dawn Tilbury highlighted recent and upcoming workshops.
 - Noteworthy workshops
 - Connecting HBCUs with Manufacturing Institutes (2019)
 - Next-generation career and technical Education for Advanced Manufacturing (2019)
 - Aligning Artificial Intelligence and Manufacturing (ongoing)
 - NSTC subcommittees, Advanced Manufacturing and Machine Learning and Artificial Intelligence
 - There will be some interesting reports coming out on how the two areas can help each other.
 - Quantum Systems (Spring 2020) – connecting multiple industries in the future.
- Network for Computational Nanotechnology (NCN)
 - www.nanoHub.org.gateway for nanotechnology research and education



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- Platform where people can upload/download software and use it for theory, modeling, and simulation in the nanoscale
- Popular platform in getting students excited and exposed to nanotechnology.
- Future Manufacturing
 - Achieve fundamental advances to enable future manufacturing by focusing on three specific domains.
 - Bio manufacturing
 - Cyber manufacturing
 - Eco-manufacturing
 - Reviewed FY20 awards in the three domains

Dawn Tilbury turns the power point presentation over to Linda Sapochak.

Linda Sapochak begins by stating that fundamental science from all areas contribute to the future of manufacturing, including those that haven't even been thought of yet. Today the topic is on the programs in chemistry and DMR that are specifically thinking about opportunities in manufacturing.

- Materials Development Continuum & the MGI Approach
 - Mission from 2014 strategic plan is to help businesses to discover, develop, and deploy new materials twice as fast at a fraction of the cost
 - Manufacturing is one of the steps to realize the strategic plan.
- Federal MGI Partners
 - NSF is engaged with multiple agencies to realize the mission.
 - Many of these agencies are also a part of the Advanced Manufacturing
- Designing Materials to Revolutionize and Engineer our Future Program
 - Implemented in response to Materials Genome Initiative
 - A collaborative process across many departments at NSF
 - Researchers are strongly encouraged to interact with industry.
 - There is a strategic partnership with the Airforce Research Laboratory
- Centers for Chemical Innovation (CCI)
 - Recent awards are related to fundamental future manufacturing development.
 - Chemistry constantly supports fundamental research that underlies advanced manufacturing research.
- Materials Innovation Platform (MIP) Programs
 - Programs centered around MGI
 - A community that has tools that are not normally available to accelerate the advancement of material research. Not a center or a traditional user facility, but a combination of both.
 - BioPacific MIP
 - Focus on the convergence of biological sciences and material sciences.
 - GlyoMIP
 - Available to the community to create feedback loops for learning.
- NSF AI Institute Program
 - Another program that is underlying manufacturing
 - Similar to a MIP Program, but from an AI approach
- NSTC Subcommittee for the Materials Genome Initiative (MGI)
 - Working on strategic plan 2.0 that is working closely with manufacturing.



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- There is a collaborative effort between MGI and Manufacturing in the planning of workshops to see where fundamental research can be connected to manufacturing.

1:50 – 2:05 PM Questions

- i. **Tabbatha Dobbins:** Are the workshops by invitation or open?

Dawn Tilbury: Some of the workshops are open and other times there is a smaller group. Sometimes it is easier to have a smaller, engaged group. Once the workshops reports come out, they are public for anyone to read and review. NSF works very hard to ensure that the people attending the workshop are representing a diverse perspective. This includes industry, academia, other government agencies and people from different geographic universities. It is important to emphasize the importance of having a diverse group because research shows it leads to a better discussion and outcomes.

Linda Sapochak: The AI and Manufacturing group report is out from the workshop Dawn Tilbury mentioned in her presentation.

- ii. **Herbert Levine:** The outflow to industry partners is important. Could you provide a little detail on the connection to industry to the manufacturing institutes?

Dawn Tilbury: The Manufacturing Institutes have a mission that is more applied than NSF's mission. NSF feels that the best way to help the Manufacturing Institutes accomplish their mission is by partnering with them. University researchers who partner with industry are invited to write proposal letters. The GOALI program is another avenue, where proposals are written with industry CO-PIs. The Manufacturing Institutes also have university partners.

Herbert Levine: Confirms he was trying to understand how the results are pushed out from the research at the Manufacturing Institutes to the industry.

Dawn Tilbury: It is the inverse as well, once research is implemented in industry, there may be a problem not thought about. Through the partnership with industry and manufacturing institutes, a virtual cycle is created.

Linda Sapochak: A congressional report recently came out on the manufacturing institutes explaining the goals of the Manufacturing Institutes and where they are going.

- iii. **Miguel Garcia-Garibay:** Are there ever any issues with intellectual property when integrating the whole process?

Linda Sapochak: There is an entire section on this topic in the recent AI workshop Dawn Tilbury discussed in the presentation.

Dawn Tilbury: There are always questions about IP. NSF doesn't send money to the university until an IP agreement is in place. In the GOALI program, the university is responsible creating IP agreement. The goal of the program is to complete precompetitive research that will benefit the manufacturing industry. Yes, IP has to be addressed, NSF has done it a lot, and there is a process.

- iv. **Robert Bryant:** To what extent are there intern opportunities for graduates and undergraduates within these manufacturing institutes.

Dawn Tilbury: Not sure on specific intern opportunities within the institutes. It could be interesting. Remember, the institutes are more of a partnership. There is no business model. NSF has an intern program that sends NSF funded graduates. It would be possible for interns selected in the intern program to go to a manufacturing institute.



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- v. **Catherine Hunt:** Mentions the GOALI program from experience with it. It did not just involve one lab or one student. The industry PI could go give a talk and interact with the whole department. It gave the student a chance to get a sense of how things work. It was interesting to see that intersection get closer together.

Meeting and Discussion with NSF Director and Chief Operating Officer - Dr. Sethuraman Panchanathan and Dr. Fleming Crim

Meeting with Director & COO

- AC chair remarks
 - New approach: flipped classroom approach of all watching Director's presentation to NSB; strong alignment with science and tech issue
 - Hopeful with progress, opportunity, and Administration focus on science
 - Excellent conversation about NSF strategic plan; submitted comments to team in February
 - COVID-19 has changed the game; opened eyes and catalyzed thinking
 - Crucial role of science in the quality of life of Americans and others
 - Basic research has enabled a change in the timeline for progress
 - You have to have basic research to have technology (final product)
 - We love the NSF mission, and it's still compelling today. But we'd like to add something: To create the foundation for technological innovation.
 - Acknowledge the cycle of tech translation without losing focus on science. Can't just do use-inspired research. "Off-the-wall" basic ideas are important, want to have a sense of direction without putting blinders on.
 - This can't be business as usual, must think about lessons from other agencies and incorporate in strategic plan.
 - Alignment with COVID-19 response, focusing on people at transition points. Can't afford to lose them. Cornelia and Miguel saw great alignment with community input on problems and solutions.
 - Facilities and research infrastructure: Talked for 2 meetings, unanimous approval for this subcommittee. Will be appointing members as early as Monday.
 - Heard final 3 presentations on IotF – Would like to ask about the directions for this at the end. Nation sees what science can give.
- Strategic Plan – AC comments (Andy Millis & others)
 - Deeply impressed and very appreciative of Steve Meacham's efforts and engagement
 - We are at a unique moment. NSF's current system for supporting all fields is creaking under the strain with the danger of collapse, and there are also incredible opportunities for science and tech. Opportunity for NSF strategic plan to be brave, resolute, daring, forward-thinking.
 - One aspect is DEI – if we're still talking 5 years from now without having done something, we will have missed the moment.
 - Engaging with technology is hard to do right. Will require careful consideration of agency's mode of operations.
 - DEI and integrating science and tech are connected; opportunity to bring in 2-year colleges and others who are left out.
 - Opportunity to expand NSF and create a new technology directorate. Pivotal moment, linkage between sci and tech is critical, lag time is closing and easier to see connections. But NSF



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must retain its autonomy without having to calculate tech impacts of basic research. Tech funding is really different, should take lessons from DARPA on nimbleness.

- COVID response – AC Comments (Cornelia Lang)
 - Feedback on major needs
 - Increased flexibility on research/training, both cost and no-cost
 - Support for people, especially early career
 - Aligned very strongly with NSF response
 - Newly energized to double down on equity & BP
 - Post-pandemic: NSF’s lessons learned on research and education; how NSF can help with broadband wireless connectivity because it’s critical for everyone
- Director’s comments
 - Fantastic work; have read your notes. Well-contextualized summaries.
 - DNA presentation on symbiosis of basic/use-inspired research – cannot and must not be disentangled. Creativity is at the intersection of the two. Don’t think separately but interwoven. Overlaps are great; mutual inspiration is important. Machine learning would not have been possible without this intertwined aspect. AI needs contributions from physics, math, other enriching areas. These are overlapping horizontals and verticals.
 - That’s what makes it unique at NSF! We are able to leverage the STE interplay, challenging each other creatively. My PhD on data compression and wavelengths is a great example. At speed, scale, strength. These are Bell Lab-like constructs!
 - Culture comment is correct – contextualize not replicate DARPA. Different community, need to preserve culture of NSF while expanding and enhancing it.
 - COVID-19: You challenged me in your comments last time on struggles of community at transition points. We need to make sure not to lose the talent – we took this as a marching order. We conserved a portion of our budget for disproportionately impacted individuals and institutions. Pending approval of current plan. Will also add the \$600M to this issue to tackle it head-on. Want this to be deployed fast, with no delay. Also understand what else needs to be done. Central focus of what we’re talking about here.
 - Let’s make sure that while unleashing talent, we’re also releasing untapped domestic talent, e.g. at MSIs. My previous meeting was with the UMD Baltimore president, assured him that we will put together initiatives that will scale (ADVANCE, INCLUDES, HBCU-UP). But also conceptualize scaling of things that they have been able to take on, like the Chan-Zuckerberg Initiative. Figure out how to scale and expand those existing efforts. Commitment to this runs deep. You will hear more about this.
 - Input to strategic plan. Fantastic ideas. Love the tagline. Will definitely consider these. We will be bold. This plan is a little different, we are taking this “decadal” moment to do something really substantive.
 - I am so excited by the Administration. Focused on science, 4 key pillars. Conversations with Eric Lander – strongly aligned. How do you unleash science for innovation in all directions? The pillar of accessibility and inclusivity within this is clearly defined.
 - Facilities and infrastructure – Nobel laureates of past years are enabled by the facilities. Thinking forward is critical. Constantly thinking about the future. Infrastructure projects currently underway, already planning for new infrastructure. Working closely with A&F, James Ulvestad (CORF), Fleming Crim (COO), ADs. Major part of our thinking.



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- Will be done in partnership. How to connect with other agencies better for national infrastructure thinking.
- Talked about quantum platforms, talked to OPP staff – imagine OPP can be so exciting for virtual immersive visualization tour. Got inspired by VLA tour. I want kiosks like that in the halls of Congress! Interactions with the Hill and fantastic, strong science supporters, working so hard to unleash opportunities for/in science. And the administration.
- IotF – Industries of Tomorrow is the same thing. Preparing workforce, talent, ideas of the future. Entrepreneurial ecosystem will emerge from that. MPS is at the foundation or the continuation of all of these areas. Outcome of a symbiotic relationship with MPS and other DIRs. A lot of fostering of early-stage tech in MPS is needed.
- AC responses
 - Thank you for your enthusiasm and energy. Transformative and crucial time for NSF; we're right here with you.
 - This is our agency, you're NSF employees! You have a Director who will listen to you and partner with you. I need your help; you are the exemplars of the community. NSF is by the community, for the community. Want community to feel supported, positive, energetic. Their ideas will get full support. You are the ambassadors – take the messages out and bring them back here.

Debrief and Conclusions

- Great exchange – Director stayed late!
- Review writing assignments – due 3/17.
- New subcommittee will feature 5 AC members + external experts. Looking for recommendations for external by next Wed. Will reach out on Monday for AC members.
- AC: What expertise do we want on external membership for subcommittee?
 - MPS: Significant high-level management, experience making high-level decisions on infrastructure and priorities. Look for diversity of thought, not just astrophysics backgrounds, and federal lab experience is appropriate.
 - People currently managing big facilities are not a priori excluded, but COI will matter. COI will depend on specific sub-charges.
 - Aiming high on principles of understanding balance of facilities across disciplines, importance of facilities, and U.S. leadership. Think of people who've written at the national level about the importance of this sort of infrastructure. Important to have a mix of perspectives of DOE/NASA backgrounds, for instance. Can complement NSF perspectives.
 - AC strongly endorses. International partners would be good too. E.g., Europe launched an enormous chips/materials initiative that might be interesting.
- AC: Thanks to Miguel and Cordelia for leading COVID discussion.
- Have talked about another doc on additional advice for strategic plan – don't think that's necessary at the moment but may come back to you in the future. Thanks to the writing team. Miracle machine was great.

Closing Remarks – AC Chair



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- Thanks to Robert Bryant and Bill Zajc for their service. Terms ending at the end of the month. Very appreciative of input.
 - Very positive experience of serving on this committee and leadership.
- We will welcome at least one new member, Edward Thomas Jr. from Auburn University.
 - MPS: Excited for him to join, plan to put him to work ASAP!
 - Looking for next meeting in June/July timeframe. There will be an email for this and November scheduling immediately after this meeting.
- Special thanks to NSF folks who've coordinated with chair on the agenda. Thanks to Kathy, Tie, Leighann, Sean.
- AC: Writing assignments – how much are we writing? This report is meant to be not minutes but summary of recommendations, observations, commendations.
- “Nothing in life is to be feared, it is to be understood. Now is the time to understand more, so we can fear less.” – Marie Curie
- MPS: Superb engagement and partnership from the AC.
- Meeting Closed at 4:15 pm