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**Before the
Committee on Commerce, Science, and Transportation
United States Senate**

**on
One Year Later: The American Innovation and Competitiveness Act**

January 30, 2018

Chairman Thune, Ranking Member Nelson, and Members of the Committee, it is a privilege to be here with you today to discuss the American Innovation and Competitiveness Act (AICA) following its one-year anniversary. There is much to celebrate.

Established by the National Science Foundation Act of 1950 (Public Law 81-507), the National Science Foundation (NSF) is an independent Federal agency whose mission is “to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes.” NSF is unique in carrying out its mission by supporting fundamental research across all fields of science, technology, engineering and mathematics (STEM) and all levels of STEM education. Investing in STEM research and education is essential to America’s prosperity, economic competitiveness, and quality of life. A vibrant scientific workforce and breakthrough discoveries enabled by NSF investments sustain, accelerate, and transform America’s globally preeminent innovation ecosystem. NSF is a respected steward of taxpayer dollars, operating with integrity, openness, and transparency.

In January 2017, the President signed into law the American Innovation and Competitiveness Act (Public Law 114-389), a bipartisan effort, led by this Committee, that reflects continued strong support for NSF’s investments in basic and collaborative research that benefit our country and the world. This support allows NSF to continue to fund incredible discoveries and advances. In fact, NSF-funded researchers account for 231 Nobel prizes, including most recently in October of last year for physics (observation of gravitational waves), economics, biology and chemistry. In all, NSF’s awards have led to transformational discoveries for the Nation – impacting Americans’ everyday lives.

The AICA also affirms NSF’s long-standing and world-renowned merit review process and addresses NSF’s implementation of issues of importance such as increased transparency and accountability, and management of multi-user facilities and mid-scale projects while maximizing research and education opportunities that help create the innovations that fuel our economy. The

AICA promotes the Foundation’s commitment to diversity in STEM fields, incentivizes NSF’s programs that encourage private-sector involvement, and re-affirms NSF’s continued commitment to entrepreneurship and commercialization.

The AICA does not change the Foundation’s portfolio of investments or the way we do business – in research, education, infrastructure, and administration – rather, it enhances and strengthens it, and serves to codify how NSF invests in science, innovation, and education.

The AICA requirements are well aligned with NSF’s mission. They vary considerably, however, in scope, complexity, and stage of development/completion. Thus, we take an intentional and strategic approach in responding to and complying with each requirement.

Oversight and Implementation of NSF’s Response to the AICA

NSF has taken an agency-wide approach in the implementation of AICA requirements. In May 2017, I established the AICA Coordinating Committee to ensure an effective and efficient agency response to the AICA. The Coordinating Committee was charged to: coordinate and oversee the implementation of NSF’s response to the AICA; produce an agency wide action plan to identify AICA sections requiring policy development or executive management decisions; and develop a central repository of AICA-related tasks, deliverables, and documentation.

I would now like to highlight some of the major provisions of the bill of special interest to the Committee, and how NSF is responding.

Title I – Maximizing Basic Research

Sec. 102 Transparency and Accountability

This section requires NSF to issue and periodically update policy guidance on the importance of transparency and accountability to the outcomes made through the merit review process. The AICA requires that each public notice of a Foundation-funded research project justify the expenditure of Federal funds by describing how the project reflects the statutory mission of the Foundation and how it addresses the Foundation’s intellectual merit and broader impacts criteria. Sec. 102 also requires that the research goals of the project are clearly identified in a manner that can be easily understood by both technical and non-technical audiences.

NSF consistently makes awards that meet the Intellectual Merit and Broader Impacts criteria and contribute to the NSF mission. Over the past year, I have met with leaders at the directorate level and at the division level to re-emphasize the need for clarity and justification in our award abstracts so that the public can understand what we are funding and why we are funding it.

To become more transparent and explicit about this process, each award abstract now includes a nontechnical description of the project, which explains the project’s significance and importance in lay language, as well as a technical description. In addition, NSF continues to enhance its staff training on the writing of titles and abstracts to improve the clarity of the award abstracts.

Finally, NSF is updating the Proposal and Award Manual, so that the final paragraph of all award abstracts will include the following common statement: “This award reflects NSF’s statutory mission and has been deemed worthy of support through evaluation using the Foundation’s intellectual merit and broader impacts review criteria.” This policy adds a direct restatement of

the AICA language to each abstract. By adding this statement, NSF affirms to all readers that every award made is aligned with our mission and is made according to our merit review process.

Sec. 109 Midscale Project Investments

This section established a definition for mid-scale projects, and directs NSF to evaluate existing and future needs for mid-scale funding. The definition of mid-scale contained in this provision aligns with NSF's current internal definition for mid-scale programs.

Instrumentation and equipment up to \$4 million has been routinely funded through the Major Research Instrumentation (MRI) program, while large-scale research infrastructure projects have been successfully funded through NSF's Major Research Equipment and Facilities Construction (MREFC) Account. The adjustment in November 2016 to lower the MREFC threshold to \$70 million was an initial step to support potential priorities in mid-scale science and infrastructure.

On October 6, 2017, NSF issued a Dear Colleague Letter: Request for Information on Mid-Scale Research Infrastructure (NSF 18-013) to assess the needs for mid-scale research infrastructure with an anticipated NSF contribution of between \$20 million and \$100 million towards construction and/or acquisition. This range is of primary interest to NSF as it will help us to identify types of projects that remain difficult to address within program budgets due to the comparatively large investment needed in a relatively short period of time.

NSF received 191 responses to the Request for Information, is currently analyzing the input, and plans to summarize the high-level insights drawn from this analysis for the science community and internal NSF use to develop possible strategies for supporting mid-scale research infrastructure.

Sec. 110 Oversight of NSF Major Multi-User Research Facility Projects

Sec. 110 strengthens oversight and accountability over NSF's large-scale research facility projects funded by the major research equipment and facilities construction account in order to maximize research investment. In response, NSF has made revisions to the *Large Facilities Manual*, the *Standard Operating Guidance*, and the *Process Narrative for A-123 Internal Controls Compliance* in order to clarify the roles and responsibilities of all organizations, including policies and procedures for planning, management, and oversight of major multi-user research facility projects, at each phase of the lifecycle. NSF has maintained a Large Facilities Office to support the research directorates and, on December 12, 2017, NSF announced that Dr. James Ulvestad will serve as the agency's first Chief Officer for Research Facilities. This position sits in the Office of the Director and reports directly to me. Dr. Ulvestad will have full lifecycle oversight responsibility for NSF major research facilities. He has initiated an NSF Facilities Governance Board for strategic issues, as well as a group of Accountable Program Officials from the relevant research directorates to provide uniform information for the full lifecycle oversight.

In response to the direction of the AICA, NSF has revised the *Large Facilities Manual* and *Standard Operating Guidance* to require external analysis of the proposed construction budget for each major multi-user facility project in accordance with the *Government Accountability Office Cost Estimating and Assessment Guide*. An independent cost estimate is now required for every proposed construction project, and an independent cost analysis of operational proposals is

required for each major multi-user research facility project. NSF has also updated its policy guidance to require a risk assessment to inform its use of business system reviews, incurred cost audits, and other oversight tools.

In addition, NSF has strengthened internal controls to improve oversight of contingency, retained control over funds budgeted for contingency, tracked contingency use, and ensured the amounts allocated to the project performance baseline are reasonable and allowable. The updated *Large Facilities Manual* and recently issued *Standard Operating Guidance* also establish guidelines for awardees regarding inappropriate expenditures associated with all fee types used in cooperative agreements.

Finally, a notification letter was provided to the Committee earlier this month on the status of NSF's implementation of the recommendations made by an expert panel of the National Academy of Public Administration in the December 2015 report, *National Science Foundation: Use of Cooperative Agreements to Support Large Scale Investment in Research*¹. In summary, NSF has addressed all the NAPA recommendations and, under the leadership of the new Chief Officer for Research Facilities, will finalize the details of implementation over the coming year. Also, I am very proud to say that in 2017, for the first time in five years, the OIG's auditor closed the Agency's Significant Deficiency in the Financial Statement Audit Report for NSF's oversight of large facility cooperative agreements.

Sec. 112. Management of the U.S. Antarctic Program

Sec. 112 requires the Director to continue to review NSF's efforts to sustain and strengthen scientific efforts in the face of logistical challenges for the U.S. Antarctic Program (USAP).

The Blue Ribbon Panel Report (BRP), [More and Better Science in Antarctica through Increased Logistical Effectiveness](#), released on July 23, 2012, outlined eleven broad areas of concern and eighty-four implementing recommendations to address those concerns. Upon receipt of the report, a "Tiger Team" of senior NSF leaders was established that developed a point-by-point response to the BRP recommendations. The National Science Board (NSB) reviewed and strongly endorsed these responses at their December 2012 and February 2013 meetings. Substantial progress was made in implementing many of the recommendations when NSF's summary response was formally released on March 19, 2013.

NSF has made steady progress on the BRP Report recommendations. The responses have addressed safety concerns, change of contractor from Lockheed Martin Polar Services to Leidos, and new management of IT systems, among other things.

The Antarctic Infrastructure Modernization for Science (AIMS) project is being undertaken to address most of the remaining concerns. AIMS is now in the final design phase to prepare for the construction phase. The AIMS program will consolidate the footprint and core facilities at McMurdo station toward significantly enhanced efficiency and cost-effectiveness of science support. AIMS will provide flexibility and resilience to sustain world-class science, and will result in a number of efficiencies including a reduction in fuel consumption and vehicle

¹ Available at <http://www.napawash.org/2015/1785-national-science-foundation-use-of-cooperative-agreements-to-support-large-investments-in-research.html>.

requirements, as well as modernized efficient buildings, and enhanced safety and improved operational and energy efficiency. NSF is committed to keeping the United States at the forefront of science and discovery in Antarctica and the recapitalization of the Antarctic infrastructure in response to the BRP is critical to doing so.

Approximately 13 USAP-related findings yielded recommendations that appeared in the Office of Inspector General's (OIG's) annual Federal Information Security Management Act (FISMA) reports in the last four years (FY 2013 thru FY 2016).² In view of NSF's responsive actions for approximately nine of the findings, the NSF OIG has closed the related recommendations. As part of the FY17 FISMA audit currently underway, the NSF OIG is evaluating NSF's responsive actions to the remaining four findings.

Title III – Science, Technology, Engineering and Math (STEM) Education

The AICA highlights some areas of STEM Education that have been key investments for NSF for many years and where we are seeing positive impacts. Several of the provisions signal Congress's support for improving K-12 STEM education, and the understanding of NSF's key role by drawing on the integration of research and education that is at the core of NSF's uniqueness.

The AICA demonstrates a commitment to drawing more people who are talented into STEM fields by inspiring them early on with excellent learning opportunities, including engagement in computer science. The AICA also focuses on government-wide coordination of STEM education (and the resulting efficiencies). NSF has played a key role in working toward this through the National Science and Technology Council (NSTC) efforts in collaboration with other agencies.

At NSF, because our education activities are integrated with science and engineering, research and innovation, we recognize that combining the best that we know from research about learning and cognition with exciting opportunities to learn STEM is a winning combination for helping to effectively inspire the next generation.

I would now like to highlight some of the major provisions of Title III, and how NSF is responding.

Sec. 303 STEM Education Advisory Panel

This section requires NSF, the Department of Education (ED), the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA) to jointly establish an advisory group made up of non-federal STEM education stakeholders. The Panel is tasked with advising the NSTC Committee on Science, Technology, Engineering, and Math Education (CoSTEM) and recommending improvements to Federal STEM Education programs.

The STEM Education Advisory Panel (the Panel) was established on October 18, 2017, under the authority of the AICA and the Federal Advisory Committee Act of 1972. The Panel will provide advice and recommendations to CoSTEM, assess CoSTEM's progress in carrying out responsibilities related to the America COMPETES Reauthorization Act, and help identify need

² Please note that a finding that was repeated, in whole or in part, during FY13-16, is counted as one finding.

or opportunity to update the Federal STEM Education 5-Year Strategic Plan. NSF, ED, NASA, and NOAA have requested recommendations for membership, and have received over 500 individual recommendations from Members of Congress, as well as the STEM education community. Going forward, the Panel will continue to accept recommendations year-round.

The heads of the Federal science agencies will work to appoint an energized and engaged group of individuals to an initial term on the STEM Education Advisory Panel in early 2018. The STEM Education Advisory Panel membership will consist of no less than 11 individuals. Members may serve on the panel for up to a three-year term. Advisory panel meetings will be held twice a year.

Sec. 305 Programs to Expand STEM Opportunities

Section 305 of the AICA reaffirms that NSF should continue to support programs designed to improve the participation of underrepresented groups in STEM. Such programs could include grants for the establishment of a Center of Excellence to increase participation of underrepresented populations in STEM fields, the purpose of which would be to build on the success of the Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (NSF INCLUDES) program.

NSF INCLUDES is a comprehensive effort to enhance U.S. leadership in science and engineering discovery and innovation by proactively seeking and effectively developing STEM talent from all sectors and groups in our society. A key objective of the NSF INCLUDES initiative is to engage current NSF awardees working on broadening participation as well as the broader STEM community in the creation and development of the NSF INCLUDES National Network.

The initiative is currently developing a National Network composed of NSF INCLUDES Design and Development Launch Pilots, NSF INCLUDES Alliances (NSF 18-529), an NSF INCLUDES Coordination Hub (NSF 17-591), NSF-funded broadening participation projects, other relevant NSF-funded projects, scholars engaged in broadening participation research, and other organizations that support the development of talent from all sectors of society to build an inclusive STEM workforce.

By building the infrastructure for partnerships, communication and collaboration, NSF aims to advance and scale up what works in broadening participation programs to reach underserved populations nationwide.

Sec. 310 Computer Science Education Research

This section requires NSF to make grants to support computer science (CS) education and computational thinking and report to Congress in the annual budget submission on the success of the program.

Since 2008, NSF has funded projects to build an evidence-based foundation for K-12 CS education and an ecosystem of curricula, course materials, assessments, scalable models of professional development and online support networks and resources for teachers. CS courses enable students to develop skills and competencies in problem-solving, critical thinking, creativity and collaboration that will help them excel in today's increasingly digital and computational world.

NSF is strongly committed to building the knowledge base - creating research and development - for computer science education, and broadening participation among underrepresented students for years to come. NSF recently released a solicitation entitled Computer Science for All: Researcher Practitioner Partnerships. This program aims to provide all U.S. students the opportunity to participate in computer science and computational thinking education in their schools at the K-12 levels. With this solicitation, NSF focuses on researcher-practitioner partnerships that foster the research and development needed to bring computer science and computational thinking to all schools.

Specifically, this solicitation aims to provide high school teachers with the preparation, professional development, and ongoing support that they need to teach rigorous computer science courses, and K-8 teachers with the instructional materials and preparation they need to integrate computer science and computational thinking into their teaching.

Sec. 311 Informal STEM Education

Section 311 of the AICA amends the STEM Education Act of 2015 to develop “a national partnership of institutions involved in informal STEM learning.” The section also encourages, “fostering and implementing on-going partnerships among institutions involved in informal STEM learning, institutions of higher education, and education research centers; and developing, adapting, and making available informal STEM education activities and educational materials for broad implementation.”

Informal STEM education programs are important for engaging the public and promoting understanding of STEM. Partnerships of many kinds are invaluable in this effort. NSF’s primary program to support informal STEM learning is the Advancing Informal STEM Learning (AISL) program in the Directorate for Education and Human Resources.

One mechanism for partnership with other directorates is the opportunity for co-funding individual projects. At present, more than 50 NSF-projects are co-funded between AISL and a program in another directorate. In addition, the AISL program itself encourages collaboration across informal STEM institutions. Two tracks of the program are specifically dedicated to partnerships, and a national center was recently awarded to a collaboration among several academic and non-governmental organizations. The purpose of this center is “to measurably advance R&D activities and findings that have the potential to improve innovation, knowledge building and networking, and the fostering of a more cohesive field of informal STEM learning.”

Looking forward, NSF will continue to encourage partnerships among diverse entities to further informal STEM education across the nation.

Title VI – Innovation and Technology Transfer

Sec. 601 Innovation Corps

The AICA encourages the development and expansion of NSF’s Innovation Corps (I-Corps) and other training programs that focus on professional development, including education in entrepreneurship and commercialization. It also encourages competitive grants, in consultation with the Small Business Innovation Research Program, to help support prototype or proof-of-

concept development and activities necessary to build local, regional, and national infrastructure for science and engineering entrepreneurship.

The NSF I-Corps program started in 2011 through the convergence of several trends in the economy, in the understanding of startup formation, and through NSF's experience with seeding startups through the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) programs. These trends strongly resonated with NSF's experience. Our data showed that of the new startups in the SBIR/STTR programs, many of which were academic spinouts developing cutting edge and state of the art deep technologies, the greatest challenge to success was more typically market failure, not technical failure that they had to overcome. We wanted to work with these trends to try something new that might better support translating cutting-edge innovations from the lab to the market.

NSF has enabled over 450 companies to develop through I-Corps teams. These companies have collectively raised over \$250 million in seed capital. Traditionally, these types of companies take 5-10 years to fully develop into commercial successes. Early fundraising and improved success rates in SBIR/STTR programs are a testament to I-Corps' value in improving the preparation of early stage startups. I-Corps programs have been adopted and adapted in partnerships with a growing number of Federal agencies, including the National Institutes of Health (NIH), Department of Energy (DOE), Department of Defense (DOD), National Security Agency (NSA), United States Department of Agriculture (USDA), Department of Homeland Security (DHS), National Aeronautics and Space Administration (NASA), and the Small Business Administration (SBA). The I-Corps model has also been adopted by the state of Ohio.

NSF is currently working to scale the I-Corps program in line with the guidance of the AICA. NSF has established an I-Corps Working Group that is focused on determining how to best meet these requirements. The Working Group has also developed a draft of metrics to evaluate program effectiveness.

In addition, to address Section 601 of the AICA, NSF currently has two pilot programs underway. The first pilot is focused on the Expansion of I-Corps, and the second pilot is focused on developing Follow-On Grants. NSF is funding eight I-Corps sites to increase participation and promote inclusion of underrepresented populations in entrepreneurship. These sites will pilot novel approaches and partnerships to engage differently-abled individuals, first-generation college students, racial and ethnic minorities and women, as well as Minority-Serving Institutions.

In collaboration with the NSF SBIR/STTR program, NSF launched the I-Corps Phase 0 pilot. This pilot supports non-academic teams of very early startups or pre-startups that are developing game-changing technologies. The Phase 0 Teams will receive national I-Corps training and participate in a follow-on curriculum called "I-Corps Go" that addresses some of the more common issues in startup formation, including incorporation, negotiation of intellectual property, and fundraising.

The I-Corps program is an integral part of the NSF strategy to stimulate innovation and address societal needs through the commercialization of the results of fundamental research. NSF will continue to work with the Committee to expand the program.

While this is not an exhaustive list of all the provisions of the AICA that impact NSF, please rest assured NSF has assigned action to each and every section through the AICA Coordinating Committee. We would be happy to provide the Committee any additional updates.

Conclusion

Mr. Chairman, I can say with certainty that the results of frontier research funded by NSF have a long record of improving lives and meeting national needs. With the support of this Committee, Congress, and the guidance provided by the AICA, NSF will continue to invest in the fundamental research and the talented people who make the discoveries that transform our future. These discoveries are a major driver of the U.S. economy, enhance our nation's security, and give the country the competitive edge needed to remain a global leader.

Thank you for the opportunity to testify today and for your continued support of NSF. I will be pleased to answer any questions.