

AN OVERVIEW OF THE
NATIONAL SCIENCE FOUNDATION
BUDGET FOR FISCAL YEAR 2014

HEARING
BEFORE THE
SUBCOMMITTEE ON RESEARCH
COMMITTEE ON SCIENCE, SPACE, AND
TECHNOLOGY
HOUSE OF REPRESENTATIVES
ONE HUNDRED THIRTEENTH CONGRESS
FIRST SESSION

WEDNESDAY, APRIL 17, 2013

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AN OVERVIEW OF THE NATIONAL SCIENCE FOUNDATION BUDGET FOR FISCAL YEAR 2014

WEDNESDAY, APRIL 17, 2013

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON RESEARCH
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Subcommittee met, pursuant to call, at 2:25 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Larry Bucshon [Chairman of the Subcommittee] presiding.

LAMAR S. SMITH, Texas
CHAIRMAN

EDDIE BERNICE JOHNSON, Texas
RANKING MEMBER

Congress of the United States
House of Representatives

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

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Subcommittee on Research Hearing

An Overview of the National Science Foundation Budget for Fiscal Year 2014

Wednesday, April 17, 2013
2:00 p.m. - 4:00 p.m.
2318 Rayburn House Office Building

Witnesses

The Honorable Dr. Cora Marrett, Acting Director, National Science Foundation

The Honorable Dr. Dan Arvizu, Chairman, National Science Board

**U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON RESEARCH**

HEARING CHARTER

An Overview of the National Science Foundation Budget for Fiscal Year 2014

**Wednesday, April 17, 2013
2:00 p.m. - 4:00 p.m.
2318 Rayburn House Office Building**

1. Purpose

On Wednesday, April 17, 2013, the Subcommittee on Research will review the Administration's fiscal year 2014 (FY14) budget request for the National Science Foundation.

2. Witnesses

The Honorable Dr. Cora Marrett, Acting Director, National Science Foundation

The Honorable Dr. Dan Arvizu, Chairman, National Science Board

3. Hearing Overview

The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense..." With a budget request of \$7.626 billion for FY 2014, 8.4% or \$593 million over FY 2012 enacted, the NSF is the funding source for over 20 percent of all federally-supported basic research conducted at almost 1,900 American colleges, universities, and other research institutions. The NSF has supported the research of over 200 Nobel Laureates, including ten Nobel prize winners named in 2012. For over 60 years, NSF investments in fundamental research have fueled scientific, technological, and engineering innovations that directly affect the everyday lives of Americans. This hearing will discuss how the Administration set funding priorities for NSF research in its FY 2014 budget request and the proposal to consolidate more Science, Technology, Engineering, and Mathematics (STEM) education within NSF, the Department of Education, and the Smithsonian Institute from other federal science agencies.

NSF Overview

The NSF is the primary source of federal funding for non-medical basic research. The NSF is the major source of federal funding for many fields like mathematics, computer science, and the social sciences. It supports the fundamental investigations that ultimately serve as the foundation for progress in nationally significant areas such as national security, technology-driven economic growth, energy independence, health care, nanotechnology, and networking and information technology.

Through over 11,700 competitive awards per year, NSF supports an average of 326,000 scientists, engineers, educators and students at universities, laboratories and field sites all over the U.S. and throughout the world. These grants fund specific research proposals that have been judged the most promising by a merit-review system.

National Science Foundation (NSF) Spending

(dollars in millions)

Account	FY12 Actual	FY13 CR/ Placeholder*	FY14 Request	FY14 Request Versus			
				FY12 Actual		FY12 Enacted	
				\$	%	\$	%
Research and Related Activities (RRA)	5758.3	5689	6212.29	453.99	7.9	523.29	9.2
<i>Biological Sciences (BIO)</i>	712.3	712.38	760.58	48.3	6.8	48.2	6.8
<i>Computer and Info. Science and Engineering (CISE)</i>	937.2	865.23	950.25	13.09	1.4	85.02	9.8
<i>Engineering (ENG)</i>	824.6	826.17	911.12	86.57	10.5	84.95	10.3
<i>Geosciences (GEO)</i>	1321.4	1321.14	1393.86	72.49	5.5	72.72	5.5
<i>Mathematical and Physical Sciences (MSP)</i>	1308.7	1308.94	1386.12	77.42	5.9	77.18	5.9
<i>Social, Behavioral, and Economic Sciences (SBE)</i>	254.2	254.25	272.35	18.16	7.1	18.1	7.1
<i>International Science and Engineering (OISE)</i>	398.6	399.44	536.62	138.02	34.6	137.18	34.3
<i>U.S. Arctic Research Commission</i>	1.5	1.45	1.4	-0.05	-3.8	-0.05	-3.8
Education and Human Resources (EHR)	830.5	829	880.29	49.75	6	51.29	6.2
Major Research Equipment & Facilities Construction (MREFC)	198.1	197.06	210.12	12.04	6.1	13.07	6.6
Agency Operations & Award Management	299.3	299.4	304.29	4.99	1.7	4.89	1.6
National Science Board (NSB)	4.4	4.44	4.47	0.1	2.3	0.03	0.7
Office of Inspector General (OIG)	14.1	14.2	14.32	0.2	1.4	0.12	0.8
FY 2013 Adjustment		43.04					
Totals:	7105.41	7076.14	7625.78	520.37	7.3	592.69	8.4

*This column represents placeholder budget for FY 2013 that NSF provided to the Committee on April 10, 2013. These amounts do not reflect the Consolidated and Further Continuing Appropriations Act of 2013 (P.L. 113-6, enacted March 26, 2013)

NSF Budget Summary¹

The FY14 budget request for NSF is \$7.63 billion, an increase of 8.4 percent, or \$593 million over the FY12 enacted level. NSF has not yet provided its actual budget for FY 2013 for the agency, as the Consolidated and Further Continuing Appropriations Act of 2013 (P.L. 113-6) was enacted on March 26, 2013. The budget for NSF is divided into three major accounts: Research and Related Activities, Education and Human Resources, and Major Research Equipment and Facilities Construction. It also includes funding requests for Agency Operations and Award Management, the National Science Board, and the Office of Inspector General.

In the NSF's FY 2014 budget presentation provided to the Committee, the NSF identified 6 priority investments, which encompass roughly 11 percent of the FY 2014 budget.

¹ <http://www.nsf.gov/about/budget/fy2014/index.jsp>

These priorities are:

- 1) Cyber-enabled Materials, Manufacturing, and Smart Systems;
- 2) Cyber-infrastructure Framework for 21st Century Science, Engineering, and Education;
- 3) NSF Innovation Corps;
- 4) Integrated NSF Support Promoting Interdisciplinary Research and Education;
- 5) Science, Engineering, and Education for Sustainability;
- 6) Secure and Trustworthy Cyberspace.

While the NSF's FY 2014 budget presentation provided to the Committee did not highlight the NSF's contribution to the Administration's Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative as a priority, \$14 million in additional spending is requested for Cognitive Science and Neuroscience. The Administration's BRAIN Initiative is a joint research project between federal science agencies— NSF, the National Institutes of Health (NIH), and the Defense Advanced Research Projects Agency (DARPA)—and private sector partners in research of brain disorders ranging from Alzheimer's and Parkinson's disease, epilepsy, autism, and injuries. President Obama announced the BRAIN Initiative on April 2nd prior to presenting his FY 2014 budget request.² The initiative has been met with some skepticism by the research community for its intent and how it might divert funds from other research.³

The NSF has also highlighted its plan to invest \$210 million in major research equipment and facilities construction (MREFC), with an initial funding request for the Large Synoptic Survey telescope, as well as funding to further development of the National Ecological Observatory Network, the Advanced Technology Solar Telescope, the Ocean Observatories Initiative, and the Advanced Laser Interferometer Gravitational-Wave Observatory.

The budget request also reflects the Administration's proposal for a government-wide reorganization of federal STEM education programs. NSF will lead the Administration's work on undergraduate STEM education with a new \$123 million program—Catalyzing Advances in Undergraduate STEM Education (CAUSE). The request also includes over \$325 million for a National Graduate Research Fellowship program, building on the current Graduate Research Fellowship (GRF) program; \$55 million for NSF Research Traineeship, building on the Integrative Graduate Education and Research Traineeship IGERT program; and over \$79 million to enhance Research Experiences for Undergraduates (REU) Sites and Supplements.

² <http://www.whitehouse.gov/blog/2013/04/02/brain-initiative-challenges-researchers-unlock-mysteries-human-mind>

³ <http://www.npr.org/2013/04/05/176303594/researchers-question-obamas-motives-for-brain-initiative>

Chairman BUCSHON. Good afternoon. Welcome to today's hearing entitled, "An Overview of the National Science Foundation Budget for Fiscal Year 2014." In front of you are packets containing the written testimony, biographies, and truth in testimony disclosures for today's witnesses.

I now recognize myself for five minutes for an opening statement.

Thank you to everyone here today for this Research Subcommittee hearing. I am pleased to welcome Acting Director, Dr. Marrett, and President Arvizu to discuss NSF's priorities for Fiscal Year 2014. Thank you both for coming.

Before we begin today's hearing, I would like to make a few comments about the recent budget proposed by the President for 2014. Today our national debt stands at almost \$17 trillion, and 62 cents of every dollar is spent on our mandatory spending or entitlement programs, and everyone pretty much agrees that these are the largest drivers of our debt. Since 2008, approximately 19 cents of every dollar has been spent on Medicare and Medicaid, and four years later we are currently spending 23 cents of every dollar on these programs. Without reform this trend will continue.

Before my time in Congress, as a cardio thoracic surgeon in Evansville, Indiana, I saw firsthand how these spiraling costs were crowding out funding for other federally-funded programs like scientific research and development.

Instead of, in my view, showing leadership, the President has spent his time in office defending a healthcare law that makes matters even worse. The Administration has not offered a pathway forward on our mandatory spending programs other than continually cutting the funding for provider reimbursement to hospitals and practitioners, risking access to quality healthcare for our Nation's seniors.

At this point I don't see any evidence the Affordable Care Act will lower medical costs in the future. Instead it continues to irresponsibly add to our yearly deficit and total national debt in spite of the rhetoric to the contrary.

Unfortunately, the proposed Fiscal Year budget from the Administration has a lot of accounting gimmicks. Because of the Administration's failed leadership and failed economic policies, we are left with non-targeted cuts in sequestration and ongoing record deficits and debt. Washington's inability to address these fiscal issues is hampering the ability of our economy to recover from recession.

Hardworking Americans who stand to benefit from the research and technology our country develops may be the victims. House Republicans have tried to address these issues by passing responsible budgets for the last three years, however, we have not—we don't control Washington, D.C. The other budgets offered from our friends on the other side have included higher taxes, more spending, and more importantly for this discussion, don't begin to address the significant drivers of our debt, and that is our mandatory programs. In addition, the budgets that have been proposed never balance.

I stress in my view if we do not address our mandatory spending programs, funding for all other Federal programs will continue to feel the financial pinch.

Imagine the high-paying jobs that will result when today's basic science discoveries turn into tomorrow's marketable technologies. Tomorrow's prosperity depends on what we do here today.

And back to our present situation and the current year budget for the National Science Foundation. We must now focus on answering what is the appropriate role of the Federal Government in funding science research. I believe by asking this and related questions we can create a stronger, more efficient National Science Foundation—nimble enough to tackle the numerous scientific challenges of tomorrow. As a Nation we must focus our scientific priorities and stretch every dollar for maximum benefit in these tight financial times.

As an example, do we need to fund studies such as the International Criminal Court in Pursuit of Justice, \$260,000 funded through NSF? I think that is a good discussion to have. These can be luxury things to fund. It would be nice to fund if we have the money, but it is not something in my view that we need to fund. This type of research may be more appropriately funded through the private sector or other government agencies.

Our charge is to ensure the American taxpayer is getting value for their hard-earned dollars that we spend on research through NSF. I strongly support NSF funding in mathematics, physics, chemistry, biology, engineering, cyber security, and STEM education, among others. Although the scientific community is not facing ideal fiscal environments, I still believe that America's best and brightest scientists will continue to persevere and produce the innovations and discoveries of tomorrow. We should support the hardworking scientist who stays up all night to repeat their experiments and doggedly pursues their ideas because they believe they are onto the next great discovery and may answer the next big question in their chosen field.

I recently visited several universities and colleges in Indiana, including Purdue University and Indiana University, and talked to NSF-funded researchers, and I was impressed. I still have a great faith and optimism in the scientific community and that its strength will continue and improve.

But for American science to succeed we must be sure that the NSF remains focused on its scientific goals and missions. I look forward to the thoughtful discussion that will ensue.

At this point I would also like to thank Ranking Member Lipinski and everyone participating in today's hearing.

[The prepared statement of Mr. Bucshon follows:]

PREPARED STATEMENT OF SUBCOMMITTEE ON RESEARCH CHAIRMAN LARRY BUCSHON

Good afternoon and thank you to everyone here for today's Research subcommittee hearing. I am pleased to welcome Acting Director Dr. Marrett and President Dr. Arvizu to discuss NSF's priorities for fiscal year 2014. Thank you both for coming.

Before we begin today's hearing, I would like to make a few comments about the President's proposed FY 2014 budget. Today, our national debt stands at almost \$17 trillion dollars. 62 cents of every dollar is spent on our entitlement programs and everyone agrees these are the largest drivers of our debt. Before President Obama took office, approximately 19 cents of every dollar was spent on Medicare and Medicaid. Four years later, this has risen to 23 cents of every dollar. Without reform this trend will continue.

Before my time in Congress, as a cardio thoracic surgeon in Evansville, Indiana, I saw first-hand how these spiraling costs were crowding out funding for other federally funded programs, like scientific research and development.

Instead of showing leadership, the President has spent his time in office defending a health care law which makes matters worse. The Administration has offered no path forward on Medicare and Medicaid other than cutting funding for provider reimbursement, risking access to quality healthcare for our nation's senior citizens.

I don't see any evidence that Obama-care will lower medical costs in the future; instead it irresponsibly adds to our yearly deficit and total national debt in spite of the misguided rhetoric to the contrary from the Administration.

Unfortunately, the President's proposed Fiscal Year 2014 budget boils down to accounting gimmicks. Because of this administration's failed leadership and failed economic policies, we are left with the non-targeted cuts in sequestration and ongoing record deficits and debt. Washington's inability to address these fiscal issues is hampering the ability of our economy to recover from the recession.

Hardworking Americans who stand to benefit from the research and technology our country develops will be the victims. House Republicans have tried to address these issues by passing responsible budgets for the past three years. However, we don't control Washington. Our friends on the other side of the aisle have offered up budgets with higher taxes and more spending, that does not address significant entitlement reform, but also never balances.

I stress, if we do not address our mandatory spending programs, funding for all other federal government programs will continue to feel the financial pinch. Imagine the high-paying jobs that will result when today's basic scientific discoveries turn into tomorrow's marketable technologies. Tomorrow's prosperity depends on what we do today. Back to our present situation, and the current year budget for the NSF. We must now focus on answering, "what is the appropriate role of the Federal government in funding science research?" I believe by asking this and related questions, we can create a stronger, more efficient NSF, nimble enough to tackle the numerous scientific challenges of tomorrow.

As a nation, we must focus on our scientific priorities and stretch every dollar for maximum benefit. As an example, do we really need a study entitled "The International Criminal Court and the Pursuit of Justice" that was funded for \$260,000 by the NSF? I think it's a nice luxury to have people study this topic. But it's not something that we need NSF to fund. This type of research is more appropriately funded by private entities or other government agencies.

Our charge is to ensure the American taxpayer is getting value for their hard earned dollars that we spend on research through the NSF. I strongly support NSF funding in mathematics, physics, chemistry, biology, engineering, cyber security, and STEM education. Although the scientific community is not facing an ideal fiscal environment, I still believe that America's best and brightest scientists will continue to persevere and produce the innovations and discoveries of tomorrow.

We should support the hard-working scientist who stays up all night to repeat her experiments and doggedly pursues her ideas, because she believes she is onto a great discovery and will answer the big questions in her field. After visiting several universities and colleges in Indiana earlier this month, my faith and optimism in the scientific community is stronger than ever. But for American science to succeed, we must make sure that the NSF remains focused on its scientific goals and missions.

I look forward to the thoughtful discussion that will ensue. I would also like to thank Ranking Member Lipinski and everyone participating in today's hearing.

Chairman BUCSHON. With that I now recognize the Ranking Member, the gentleman from Illinois, Mr. Lipinski, for an opening statement.

Mr. LIPINSKI. Thank you, Chairman Bucshon, for holding this hearing, and I want to welcome Dr. Marrett and Dr. Arvizu.

Let me begin by saying that I understand that America faces a serious debt threat. If we don't do anything to reign in our long-term debt our economic future will be imperiled. Solving this problem requires some budget cuts, but I hope that going forward we can make these cuts in a smart way that addresses the various near-term and long-term challenges that our Nation faces.

In doing this we will have to set priorities. Sometimes when you set priorities, this will mean cutting spending, and sometimes it

may mean increasing investments in areas that deliver real returns for taxpayers by improving our quality of life, protecting our population from natural and manmade threats, and ensuring our economic competitiveness.

Therefore, I am pleased that the Administration's Fiscal Year 2014 budget request continues to emphasize science, innovation, and STEM education generally and the National Science Foundation in particular.

Even though NSF has fared well in recent appropriations bills, continued uncertainty over funding levels has hurt scientific progress. The agencies and universities can't plan. Some of the best and brightest give up and leave their labs, and the younger generation sees what their mentors are up against and choose a different path altogether.

Our own Committee will have the opportunity to weigh in on budget and programmatic priorities across the agency as we consider an NSF Reauthorization Bill sometime in the next several weeks. So I appreciate this opportunity to learn more about the nature and scope of research and STEM education activities proposed in the budget.

Let me just comment on a few of the priorities described in the budget. First, you will not be surprised that I am excited to see the proposed increase in the I-Corps Program. As I have said many times now, I strongly believe that this program embodies the NSF's original mission of both promoting the progress of science and advancing the national prosperity. Although it is only a fraction of a percent of NSF's budget, early results support my long-held belief that I-Corps will yield exponential benefits, helping turn NSF's research investments into new companies and jobs for the benefit of all Americans.

Last summer I hosted a field hearing in Chicago to learn more about this program and its early successes. For my new colleagues who haven't looked at this program in depth, it is important to note that this program educates scientists on how to develop viable commercial products from their research. It connects them with like-minded venture capitalists and entrepreneurs.

The final decisions on whether or not to commercialize research still rests with the scientists in question, and of course, with the private sector which would fund the ideas. Already we are seeing results with I-Corps graduates such as Neon receiving venture capital funding for a product developed through the program. This public-private partnership is in the best tradition of U.S. science policy, and I look forward to working with the NSF as this program develops.

Second, I am pleased with the continued emphasis on Advanced Manufacturing at NSF and several other agencies. We must regrow our American manufacturing base and we will not do it with the technologies and processes of yesterday. But the small and medium-sized industries that comprise a significant portion of our manufacturing capacity can't do it all on their own, and they certainly don't have the resources or capacity to invest in most far-reaching R&D. NSF plays a critical role in funding basic research with potential application to advanced manufacturing technologies and processes of the future.

There are many other interesting proposals in this budget request, including the increased focus on big data, the expansion of the INSPIRE Program to support interdisciplinary research and NSF's plan to begin to implement the OSTP Policy Memorandum on public access to the results of federally-funded research. It is also good to see that all the current MREFC projects are on track, and NSF is moving ahead with the Large Synoptic Survey Telescope.

I will wrap up with a few comments and questions about the agency's proposals for consolidating many of its STEM education programs, both within the agency and as part of the Administration's federal-wide STEM reorganization. Mostly I would like to hear more details about all of these proposals because some of them seem to still be rough sketches.

For example, with respect to the consolidated National Graduate Research Fellowship Program, I have no doubt that NSF's own graduate research fellowships will continue without disruption, but I wonder how NSF will work with the mission agencies to ensure that their mission-specific needs are being met through this new consolidated national program administered by NSF.

I would also like to understand better what is being proposed for graduate traineeships and what is new about the consolidated undergraduate program or if it is mostly a repackaging of existing programs. I suspect many of my colleagues will have STEM questions for you today also.

With that I want to thank, again, Dr. Marrett and Dr. Arvizu, for being here today. I look forward to your testimony and our discussion.

With that I will yield back.

[The prepared statement of Mr. Lipinski follows:]

PREPARED STATEMENT OF RANKING MINORITY MEMBER DANIEL LIPINSKI

Thank you Chairman Bucshon for holding this hearing and welcome Dr. Marrett and Dr. Arvizu.

Let me begin by saying that I understand that America faces a serious debt threat. If we do not do anything to rein-in our long-term debt, our economic future will be imperiled. Solving this problem will require some budget cuts. But I hope that going forward we can make these cuts in a smart way that addresses the various near-term and long-term challenges that our nation faces.

In doing this, we will have to set priorities. Sometimes priority-setting means increasing investments in areas that deliver real returns for taxpayers by improving our quality of life, protecting our population from natural and man-made threats, and ensuring our economic competitiveness. Therefore, I am pleased that the Administration's FY14 budget request continues to emphasize science, innovation, and STEM education generally, and the National Science Foundation in particular.

Even though NSF has fared well in recent appropriations bills, continued uncertainty over funding levels has hurt scientific progress. The agency and universities can't plan, some of the best and brightest give up and leave their labs, and the younger generation sees what their mentors are up against and choose a different path altogether.

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There are many other interesting proposals in this budget request, including the increased focus on big data, the expansion of the INSPIRE program to support interdisciplinary research, and NSF's plans to begin to implement the OSTP policy memorandum on public access to the results of federally funded research. It's also good to see that all of the current MREFC projects are on track and NSF is moving ahead with the Large Synoptic Survey Telescope.

I will wrap up with a few comments and questions about the Agency's proposals for consolidating many of its STEM education programs, both within the Agency and as part of the Administration's federal-wide STEM reorganization. Mostly, I'd like to hear more details about all of these proposals, because some of them seem to be still just rough sketches. For example, with respect to the consolidated National Graduate Research Fellowship Program, I have no doubt that NSF's own graduate research fellowships will continue without disruption, but I wonder how NSF will work with the mission agencies to ensure that their mission-specific needs are being met through this new consolidated national program administered by NSF. I'd also like to understand better what's being proposed for graduate traineeships, and what's new about the consolidated undergraduate program, or if it's mostly a repackaging of existing programs. I suspect many of my colleagues will have STEM questions for you today.

I thank Dr. Marrett and Dr. Arvizu for being here today; I look forward to your testimony and our discussion.

Chairman BUCSHON. Thank you, Mr. Lipinski.

I now recognize the Chairman of the full Committee, Chairman Smith, for an opening statement.

Chairman SMITH. Thank you, Mr. Chairman, and I want to follow up on your good opening statement in regard to the National Science Foundation funding.

We are now in a situation where we must maximize every dollar being spent by every Federal agency. Our focus should be on how the Federal Government, including the National Science Foundation, can maximize returns from taxpayer-funded research. How can the NSF better prioritize which areas of science and engineering it supports?

The NSF has great potential to help American science flourish and thus contribute to our economy and the wellbeing of our country. But in my view the NSF has funded several studies that should not have been approved. However, I do not think that we should pick winners and losers by micromanaging grant decisions at the NSF. It is the responsibility of the professionals at the NSF

to exercise their best judgment and ensure that only proposals that benefit the taxpayer get funded. It is Congress' job to ensure accountability and transparency for the American taxpayer. How do we avoid micromanaging but achieve accountability at the National Science Foundation? And how do we ensure an environment where the creativity and the determination of our very best scientists is encouraged?

Mr. Chairman, let me stop there but say that I hope that our witnesses will be able to address some of these questions. They are not easy, and it requires, I think, a common understanding and appreciation for what the National Science Foundation does but also a recognition that we may be able to improve the process whereby the NSF grants are approved.

I yield back. Thank you.

[The prepared statement of Mr. Smith follows:]

PREPARED STATEMENT OF CHAIRMAN LAMAR SMITH

Thank you , Mr. Chairman. And I want to follow up on your good opening statement in regard to the National Science Foundation (NSF) funding.

We are now in a situation where we must maximize every dollar being spent by every federal agency.

Our focus should be on how the federal government, including the National Science Foundation, can maximize the returns from taxpayer-funded research.

How can the NSF better prioritize which areas of science and engineering it supports?

The NSF has great potential to help American science flourish and thus contribute to our economy and the well-being of our country.

But in my view, the NSF has funded several studies that should not have been approved. However, I do not think that we should pick winners and losers by micromanaging grant decisions at the NSF.

It is the responsibility of the professionals at the NSF to exercise their best judgment and ensure that only proposals that benefit the taxpayer get funded.

It is Congress' job to ensure accountability and transparency for the American taxpayer. How do we avoid micromanaging but achieve accountability at the National Science Foundation?

And how do we ensure an environment where the creativity and the determination of our very best scientists is encouraged?

Mr. Chairman let me stop there but say that I hope that our witnesses will be able to address some of these questions.

They are not easy and it requires, I think, a common understanding and appreciation for what the National Science Foundation does. But also recognition that we may be able to improve the process whereby the NSF grants are approved. And I yield back.

Chairman BUCSHON. Thank you, Mr. Chairman. At this time I would like to introduce our witnesses. Our first witness is Dr. Cora Marrett, the Acting Director of the National Science Foundation. She has served in this role since March 2013, and was previously confirmed as NSF's Deputy Director in May 2011. Prior to that Dr. Marrett served as the NSF as the Assistant Director for Education and Human Resources and the Assistant Director for the Social Behavioral and Economic Sciences. She has also held positions at the University of Wisconsin and the University of Massachusetts at Amherst. Dr. Marrett has a Bachelor of Arts from Virginia Union University and a Master of Arts and a Doctorate from Wake Forest University. Welcome.

Our next witness is Dr. Dan Arvizu, Chairman of the National Science Foundation Board. In 2004, Dr. Arvizu was appointed by President George W. Bush for a six-year term on the National

Science Board and in 2010, was reappointed by President Barack Obama to a second six-year term. In 2012, Dr. Arvizu was elected as Chairman of the NSB. Dr. Arvizu is the Director and Chief Executive of the Department of Energy's National Renewable Energy Laboratory. Dr. Arvizu has a Bachelor of Science degree in mechanical engineering from New Mexico State University and a Master of Science degree and Ph.D. in mechanical engineering from Stanford University.

As our witnesses should know, spoken testimony is limited to five minutes each, after which the Members of the Committee will have five minutes each to ask questions.

I now recognize Dr. Marrett for five minutes to present her testimony.

**TESTIMONY OF THE HONORABLE CORA MARRETT,
ACTING DIRECTOR, NATIONAL SCIENCE FOUNDATION**

Dr. MARRETT. Thank you, Chairman Bucshon, Ranking Member Lipinski, and Members of the Subcommittee. It is indeed my privilege to be able to be here with you today to present the National Science Foundation's budget for the 2014 fiscal year.

NSF is the only Federal agency dedicated to support basic research and education in all fields of science and engineering. That wide-angle vision has permitted unprecedented developments over the past 60 years and seems especially imperative for the complex problems and the question that the Nation currently faces.

Our mission and our reach can be expressed quite simply. We empower the discoveries that keep our Nation at the forefront, the forefront of the world's innovation enterprise. So for more than six decades we have supported fundamental research and education that has pushed forward the frontiers of scientific knowledge.

We allocate 94 percent of our budget directly in support of research, education, and scientific infrastructure. That means we work with a very lean six percent administrative overhead. We invest directly into the Nation's research and development enterprise by making approximately 10,000 merit-reviewed awards to researchers and educators in all disciplines.

It is only with a strong commitment and partnership with Congress, and this Subcommittee specifically, that we have created and refined the world's gold standard for science funding. That standard having to be merit review. We greatly appreciate the long-standing support of the full Committee, the Subcommittee for the strong model that we have in place.

The request before you is for \$7.6 billion. This is an increase of \$500 million over Fiscal Year 2012. We know this is an era of fiscal restraint that requires difficult trade-offs. The overall support for NSF reflects the Administration's clear determination to build on the Nation's history of success and leading-edge discovery and innovation.

Most of our funding goes into core fundamental research, but we also make major targeted investments that enable cutting-edge research. As we look at the infrastructure that is necessary, these encompass telescopes, ships, other facilities and capabilities. Some of our best examples draw on NSF's legacy of funding visionary computer science, and this is a part of a comprehensive portfolio of ad-

vanced computational infrastructure, infrastructure programs, and other resources.

In the last year we launched three new advanced facilities. Yellowstone at the National Center for Atmospheric Research in Wyoming, Stampede at the Texas Advanced Computing Center, thank you very much, Mr. Smith, for being there, Blue Waters at the University of Illinois with Mr. Lipinski. The recently-launched Alaska Region Research Vessel, Sikuliaq, will soon embark on its first science mission. It will explore the Arctic to advance our understanding of the climate and oceanography.

Our priority investment in secure and trustworthy cyberspace offers a different kind of example of NSF's contribution to the Nation. This program will help protect the Nation's critical information technology infrastructure, including the Internet, from a wide range of threats. We are educating the next generation cybersecurity workforce, helping to transition what has been learned in the laboratory into day-to-day practice.

The budget request also continues NSF's long history of support for the next generation of leaders in other fields of science, technology, engineering, and mathematics or STEM education. This is a part of the Administration's multiagency effort to increase the impact of Federal investments in STEM achievement.

NSF will support the efforts of almost 340,000 researchers, post-doctoral fellows, teachers, and students. More than ever the future prosperity and well-being of Americans depend on sustained investments in science and engineering. NSF promises to continue to be central to that effort.

Mr. Chairman and Members of the Subcommittee, I hope this summary has given you an idea of how important the National Science Foundation is to our Nation's progress, and I look forward to the dialogue that will follow.

Thank you.

[The prepared statement of Dr. Marrett follows:]



**Dr. Cora Marrett
Acting Director
National Science Foundation**

**Before the
Committee on Science, Space, and Technology
Subcommittee on Research
United States House of Representatives**

April 17, 2013

Chairman Bucshon, Ranking Member Lipinski, and Members of the Subcommittee, it is my privilege to be here with you today to present the National Science Foundation's budget for the 2014 fiscal year.

For more than six decades the National Science Foundation has had a profound impact on our nation's innovation ecosystem by funding transformative research that has pushed forward the frontiers of scientific knowledge. As the only Federal agency dedicated to the support of basic research and education in all fields of science and engineering, NSF empowers discoveries across a broad spectrum of scientific inquiry.

Each year, NSF awards thousands of grants that engage the talents of researchers, postdoctoral fellows, trainees, teachers and students. Collectively, NSF-funded researchers have won more than 200 Nobel Prizes for their work in the fields of chemistry, economics, physics and physiology and medicine.

In an era of fiscal austerity and focus on return on investment for the U.S. taxpayer, the strategic investments in NSF's FY 2014 portfolio sustain national economic growth, create new high technology jobs, support the transition to a clean energy economy, and train and develop the Nation's globally competitive science and engineering (S&E) workforce. NSF's comprehensive commitment to empower discoveries helps keep our nation at the very forefront of the world's science-and-engineering enterprise.

NSF's FY 2014 Budget Request is \$7.626 billion, an increase of \$592.69 million (8.4 percent) over the 2012 Enacted level. This request reflects a rigorous prioritization of activities across the Foundation. Even as the overall budget grows, the Agency Operations and Award Management account increases only \$4.89 million (1.6 percent) as administrative costs are kept constrained. Approximately \$37 million in lower priority education and research programs are terminated, reduced, or consolidated.

With this budget request, the Administration has conveyed its determination to build on the nation's history of success in leading-edge discovery and innovation.

NSF has identified critical funding priorities that will provide long-term benefits for the nation. We have made difficult choices to reduce or eliminate lower priority programs, and seized opportunities to leverage resources for maximum impact.

FY 2014 PRIORITIES

The investments that form this Budget Request flow from the goals established in the agency's strategic plan: Transform the Frontiers, Innovate for Society, and Perform as a Model Organization. In FY 2014, key NSF investments in all fields of science and engineering strive to create new knowledge, enable discovery, address complex societal problems, and promote national prosperity.

In keeping with NSF's mission of advancing basic research in science, engineering, and education, this Request ensures the health of fundamental science and engineering across all disciplines, primarily through merit reviewed awards to researchers at colleges and universities throughout the country. There are six areas where core research is encouraged to enable scientists to address problems that require integration across more than one discipline. These priority investments, which encompass roughly 11 percent of the FY 2014 Request, focus on areas where progress in basic research is vital to addressing key national challenges, such as spurring innovation in manufacturing, improving data storage and analysis (e.g., Big Data), securing critical infrastructure, and promoting innovation and economic growth generally. Priorities include:

- **Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS)** (\$300.42 million) will transform static systems, processes, and edifices into adaptive, pervasive "smart" systems with embedded computational intelligence that can sense, adapt, and react. Through CEMMSS, NSF participates in the Administration's Materials Genome Initiative (MGI), the National Robotics Initiative (NRI), and the Advanced Manufacturing Partnership. These investments fund research in areas of national importance, such as cyber-physical systems and advanced robotics research, materials processing and manufacturing, and advanced semiconductor and optical device design. These efforts are integral to the Administration's overall emphasis on strengthening advanced manufacturing.
- **Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21)** (\$155.47 million) aims to expand investment in the Big Data/National Data Infrastructure program, a joint solicitation with the National Institutes of Health (NIH). NSF, as the lead agency, strives to coordinate development of new knowledge, tools, practices, and infrastructure that will enable breakthrough discoveries in science, engineering, medicine, commerce, education, and national security.
- **NSF Innovation Corps (I-Corps)** (\$24.85 million) continues to build a national innovation ecosystem by improving NSF-funded researchers' access to resources that can assist in bridging the gap between discoveries and downstream technological applications, including commercialization of new technologies, products, and processes. In FY 2014, NSF will continue investment in Innovation Teams, and will expand support for I-Corps Nodes and I-Corps Sites.
- **Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE)** (\$63.0 million) investment will continue to strengthen NSF's support of interdisciplinary, potentially transformative research by complementing existing efforts with a suite of highly innovative Foundation-wide activities and funding opportunities.
- **Science, Engineering, and Education for Sustainability (SEES)** (\$222.79 million) addresses the need to develop a sustainable world where human needs are met equitably without harm to the environment and without sacrificing the ability of future generations to meet their needs. SEES uses a systems-based approach to understanding, predicting, and reacting to change in the linked natural, social, and built environment and addresses challenges in environmental and energy research and

education. In FY 2014, NSF focuses on enhancing the Water Sustainability and Climate, Cyber-SEES, Hazards, and Sustainable Chemistry, Engineering and Materials (SusChEM) programs.

- The **Secure and Trustworthy Cyberspace (SaTC)** (\$110.25 million) investment aligns NSF's cybersecurity investments with the four thrusts outlined in the national cybersecurity strategy, *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program*. SaTC seeks to protect the Nation's information technology infrastructure from a wide range of threats that challenge its security, reliability, availability, and overall trustworthiness.

Additional Priorities and Highlights

- NSF aims to increase the operational efficiency of **U.S. activities in the Antarctic** (\$22.0 million) by implementing the recommendations of the U.S. Antarctic Program Blue Ribbon Panel (BRP) report, *More and Better Science in Antarctica through Increased Logistical Effectiveness*. Emphases include safety and health improvements, investments with positive net present value, and facilities renewal at McMurdo and Palmer stations. Additionally, NSF aims to plan and execute more effective observational approaches to the Antarctic science community, as outlined in the 2011 National Research Council report, *Future Science Opportunities in Antarctica and the Southern Ocean*.
- In FY 2014, NSF introduces three activities to improve program effectiveness and efficiency by:
 - Ensuring **Public Access** (\$2.50 million) to NSF research. This initiative reflects the Administration and NSF priority to make government more open and accessible by improving public access to NSF-funded research. In FY 2014, NSF establishes a policy framework that will build on and refine existing technology to track research products, allow investigators and awardees to make their products known and available, and allow the general public, researchers, and policy makers to locate and make use of those products. This effort includes establishing a publicly-accessible repository for publications, leveraging existing federal infrastructure to the maximum extent possible.
 - Establishing an **Evaluation Capability** (\$5.50 million) to improve NSF's ability to inform policy decisions and improve the impact of research grant investments. In FY 2014, NSF will build a central evaluation expertise and support capability to promote rigor, transparency, and independence of evaluations. The centralized capability will coordinate the evaluation of NSF-wide activities, expand data collection, and ensure that the results of evaluation are used to improve NSF programs.
 - Improving the operational execution of the **Merit Review Process** (\$4.09 million), an essential step to address the extraordinary pressures the Foundation faces due to a growing number of proposals and intense competition for NSF funding. The FY 2014 Request will support a multi-year effort to improve major aspects of this process, including use of virtual meeting technologies for merit review; technological support for the management of reviewers and reviews; increased automation of the preliminary processing of proposals; and demand management.
- **Clean Energy** (\$372.45 million): NSF's clean energy investments include research related to sustainability science and engineering, such as the conversion, storage, and distribution of diverse power sources (including smart grids), and the science and engineering of energy materials, energy use, and energy efficiency.
- **Research at the Interface of Biological, Mathematical and Physical Sciences, and Engineering (BioMaPS)** (\$50.67 million) is a collaboration among the Directorates for Biological Sciences,

Mathematical and Physical Sciences, and Engineering, that seeks to discover fundamental knowledge at the intersections of these established disciplines. This activity will produce critical knowledge needed to catalyze the development of new technologies essential to the Nation's prosperity and economic competitiveness and will advance emerging areas of the bioeconomy, as described in the Administration's *National Bioeconomy Blueprint*.

- **The Cognitive Science and Neuroscience** investment (\$13.85 million) supports a focused, cross-foundation activity with three multi-year goals: to advance understanding of adaptation to the ever-changing world; to determine the mechanisms underlying decision-making and problem-solving in a dynamic environment; and to break the neural code by elucidating how the brain represents the world around us. This builds on ongoing NSF-wide support (approximately \$70 million per year) for fundamental research relevant to cognitive science and neuroscience. NSF's funding in FY 2014 will also contribute to the Administration's multi-agency research initiative designed to revolutionize understanding of the human brain. FY 2014 activities include workshops held to identify specific gaps in our current understanding of these issues and intractable technology problems that prevent scientific breakthroughs. These will allow development of a framework for future efforts in the Administration's initiative.
- **The Faculty Early Career Development program (CAREER)** (\$223.73 million) develops the future STEM workforce through support of young faculty who are dedicated to integrating research with teaching and learning. In FY 2014, NSF will support approximately 500 new awards. The CAREER portfolio includes projects that range across all fields of science and engineering supported by the Foundation, including high priority fields such as clean energy, climate change, STEM education, and cybersecurity. Within CAREER, NSF will support more fully utilizing the talents of individuals in all sectors of the American population by promoting Career-Life Balance, including supplemental funding requests to employ research technicians or the equivalent for up to three months to sustain research when principal investigators are on family leave.

Science, Technology, Engineering, and Mathematics (STEM) Education

NSF maintains a strong commitment to advancing science and engineering education at all levels and to strengthening the Nation's workforce in STEM. The Administration is proposing a government-wide reorganization of STEM education programs to support a cohesive national STEM strategy. As part of this reorganization, in FY 2014 NSF presents a comprehensive agency-wide program to address undergraduate education and expands its leadership role in graduate education.

- **Catalyzing Advances in Undergraduate STEM Education (CAUSE)** (\$123.08 million) is a comprehensive agency-wide program for FY 2014 that aims to maximize the impact of NSF's considerable ongoing investments in STEM undergraduate education. CAUSE aims to improve STEM learning and learning environments; broaden participation in STEM and increase institutional capacity; and build the STEM workforce of tomorrow.
- Funding for the **Research Experiences for Undergraduates (REU) Sites and Supplements** (\$79.18 million total) is increased \$13.19 million over the FY 2012 Enacted. This additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*.

- The **National Graduate Research Fellowship program (NGRF)** (\$325.14 million) builds on and expands the longstanding NSF Graduate Research Fellowship program (GRF) to incorporate features and opportunities that allow fellows to gain specialized experiences and training in key STEM areas. Through this expanded program, an increase of approximately 700 fellows is expected, bringing the total estimated number of new fellows awarded in FY 2014 to 2,700.
- The **NSF Research Traineeships (NRT)** program (\$55.07 million) is the Foundation's investment in traineeships that focus on strategically identified research areas, mutually leveraging NSF's traineeship and research investments. NRT will build on NSF's previous investments – particularly the Integrative Graduate Education and Research Traineeship (IGERT) program – to encourage effectual innovation and design of graduate programs to support opportunities within specific disciplines.

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION

In FY 2014, NSF requests funding to continue construction of four projects: the Advanced Laser Interferometer Gravitational-Wave Observatory (AdvLIGO), the Advanced Technology Solar Telescope (ATST), the National Ecological Observatory Network (NEON), and the Ocean Observatories Initiative (OOI).

Funds are also requested to begin construction of the Large Synoptic Survey Telescope (LSST), a partnership with the Department of Energy (DOE). LSST was ranked as the number one priority for a large ground-based astronomical facility in the National Academies' most recent *Decadal Survey of Astronomy and Astrophysics* (August 2010).

- **Advanced Laser Interferometer Gravitational-Wave Observatory (AdvLIGO).** A planned upgrade of the existing Laser Interferometer Gravitational-Wave Observatory (LIGO), AdvLIGO will be ten times more sensitive, powerful enough to approach the ground-based limit of gravitational-wave detection.
- **Advanced Technology Solar Telescope (ATST).** ATST will enable study of the sun's magnetic fields, which is crucial to our understanding of the types of solar variability and activity that affect Earth's civil life and may impact its climate.
- **Large Synoptic Survey Telescope (LSST).** LSST will produce an unprecedented wide-field astronomical survey of our universe, including the deepest, widest-field sky image ever. The LSST survey will change every field of astronomical study, from the inner solar system to the large scale structure of the universe.
- **National Ecological Observatory Network (NEON).** NEON will consist of geographically distributed field and lab infrastructure networked via cybertechnology into an integrated research platform for regional to continental scale ecological research.
- **Ocean Observatories Initiatives (OOI).** OOI will enable continuous, interactive access to the ocean via multiple types of sensors linked by cutting-edge cyberinfrastructure, which will produce never-before-seen views of the ocean's depths.

MODEL ORGANIZATION

To "Perform as a Model Organization" is an internally focused strategic goal that emphasizes the agency's desired outcome of attaining excellence in all aspects of its operations. Model Organization underpins NSF programmatic activities and encompasses all the agency's management activities. It also includes support for the activities of the Office of Inspector General (OIG) and the National Science Board (NSB), which are provided in separate appropriations.

iTRAK

NSF will continue to modernize its financial management systems through the implementation of iTRAK. iTRAK will transition NSF from its legacy financial system to a fully integrated financial management solution. In FY 2014, the total request for iTRAK is \$2.60 million.

Promoting Efficient Spending

Efforts are underway in multiple accounts to reduce administrative costs through efficiencies in response to the Administration's Promoting Efficient Spending initiative (Executive Order 13589) and *Promoting Efficient Spending to Support Agency Operations* (OMB M-12-12). Travel costs across NSF will be held at no more than \$27.67 million in FY 2014, an amount \$5.60 million below FY 2010 levels. This is accomplished through strategic efficiencies that achieve savings while preserving the travel necessary for mission-critical oversight and management responsibilities. In addition, NSF will also employ strategic sourcing of administrative support contracts, specifically for printing and wireless devices.

PERFORMANCE AND EVALUATION

NSF embraces the use of goals to drive performance improvements. In FY 2014, NSF has set ten performance goals so that NSF can strategically monitor and oversee progress being made on the Foundation's most important activities: priority program investments, research infrastructure investments and key management initiatives. NSF's goals are:

- **Ensure that Key Program Investments are on track:** Meet critical targets for several key program investments: CEMMSS, CIF21, I-Corps, INSPIRE, SaTC, and SEES. Progress will be monitored using a set of common milestones and indicators.
- **Ensure that Infrastructure Investments are on track:** Ensure program integrity and responsible stewardship of major research facilities at varying stages of their lifecycle. This involves construction project monitoring, response to advisory reports, and deployment of the first implementation of the NSF Public Access system.
- **Use Evidence to Guide Management Decisions:** The Foundation will use evidence-based reviews to guide management investments.
- **Improve Undergraduate Education:** The Foundation will establish an NSF-wide undergraduate STEM education program that is evidence-based and evidence-building.
- **Enhance National Graduate Research Fellowships:** NSF will enhance the Graduate Research Fellowship program to provide a wider range of career development opportunities.
- **Promote Career-Life Balance Policies and Practices:** NSF aims to promote policies and practices that support more fully utilizing the talents of individuals in all sectors of the American population, principally women, underrepresented minorities, and persons with disabilities.
- **Foster an Environment of Diversity and Inclusion:** The Foundation seeks to foster an environment of diversity and inclusion while ensuring compliance with the agency's civil rights programs.
- **Modernize Financial System:** iTRAK is the Foundation-wide effort to transition NSF from its legacy financial support system to a fully integrated financial management shared services solution to ensure continuous improvement and achieve high levels of customer service.

- **Make Timely Award Decisions:** NSF aims to inform applicants whether their proposals have been declined or recommended for funding within 182 days, or six months of deadline, target, or receipt date, whichever is later.
- **Enable Increased Use of Virtual Merit Review:** NSF seeks to incorporate technological innovations into the merit review process by expanding the use of virtual merit review panels.

CUTS, CONSOLIDATIONS, AND SAVINGS

NSF's FY 2014 Request follows a thorough examination of programs and investments across NSF to determine where the potential exists for more innovative investments. In addition to last year's proposals, this Request includes six terminations; two reductions; and one consolidation, totaling \$36.86 million below the FY 2012 Enacted level.

Nanoscale Science & Engineering Centers (NSECs) (-\$18.61 million): six NSEC centers are terminated due to center graduations and a transition to the Nanosystems Engineering Research Centers (NERCs) program. NSF will continue to support five continuing NSECs in FY 2014.

Two programs are eliminated within the Directorate for Mathematical and Physical Sciences (MPS). **CCAT** (formerly the Cerro Chajnantor Atacama Telescope) **Design and Development** (-\$1.50 million total) concludes in FY 2013. Future NSF contributions to construction and/or operations will depend on a successful proposal to a competed midscale activities program. The **International Materials Institutes (IMI)** (-\$1.58 million total) were concluded after an internal evaluation of program achievements found that despite the success of individual projects, the collective effort has not made the intended impact.

Virtual Organizations (-\$5.0 million total) has achieved its programmatic goals to support scientific research to advance understanding of the effectiveness of virtual organizations and how they can enable and enhance science and engineering research and education. The transition to supporting application of virtual organizations to science and engineering communities is now underway in multiple programs within the Directorate for Computer and Information Science and Engineering.

The **Sensors and Sensing Systems (SSS)** program (-\$3.0 million) is reduced because there are other programs both within NSF and at other agencies that principal investigators can apply to for support. The program will be refined to have a narrower and more targeted focus.

University Radio Observatories (UROs) (-\$1.80 million) is being superseded scientifically by NSF's Atacama Large Millimeter/submillimeter Array (ALMA). It is expected that UROs will be eligible to compete for future funding in a broader midscale activities program.

The Directorate for Education and Human Resources (EHR) will shepherd two major realignments to the current NSF STEM Education portfolio in order to use existing resources more effectively through a streamlined and consolidated approach. The new **Catalyzing Advances in Undergraduate STEM Education (CAUSE)** program includes undergraduate programs in EHR as well as Research and Related Activities (R&RA) directorates. NSF will take a leadership role in the coordination of government-wide graduate STEM education programs while developing national fellowship and traineeship programs.

As part of NSF's realignment of its STEM Education portfolio, two programs are terminated within the Directorate for Geosciences (GEO). The goals of the **Geoscience Teacher Training (GEO-Teach)** (-\$2.0 million) program continue to be served through other STEM education initiatives at NSF. The **Centers for Ocean Science Education Excellence (COSEE)** (-\$3.37 million) is terminated as the

program has fulfilled its original goals. GEO will turn its attention to new educational initiatives through CAUSE.

Concluding Remarks

Mr. Chairman, let me close with the words of the scientist and statesman Benjamin Franklin, “An investment in knowledge pays the best interest.”

We take for granted such technological marvels as lasers, computers, the Internet, wireless communications, weather-observing satellites, advanced medicines, and others. And yet those technologies would not exist without the scientific discoveries that made them possible. Those discoveries have fostered long-term economic growth, educated the next generation of scientists and engineers, and addressed critical national needs.

NSF-empowered discoveries have returned unimagined dividends to the American people. To keep those benefits flowing, we need to constantly replenish the wellspring of new ideas and train new talent while serving as good stewards of the public trust. This is the fundamental and continuing mission of NSF.

The Foundation plays a vital role in ensuring that America remains at the epicenter of the ongoing revolution in research and discovery that is driving twenty-first century economies. More than ever, the future prosperity and well-being of Americans depend on sustained investments in science and engineering, and NSF will continue to be central to that effort. The FY 2014 budget request acknowledges the Foundation’s pivotal role in ensuring America’s future.

Mr. Chairman and members of the Subcommittee, I hope that this overview has given you a taste of just how very important the National Science Foundation and its activities are to the future prosperity of the United States. I look forward to working with you in months ahead, and I am happy to answer any questions you may have.



Dr. Cora B. Marrett
Acting Director
National Science Foundation

Photo by Sandy Schaeffer

Cora B. Marrett is Acting Director of the National Science Foundation. Since January 2009, she served as NSF's acting Director, acting Deputy Director, and Senior Advisor, until her confirmation as Deputy Director in May 2011.

Before January 2009, Marrett was the Assistant Director for Education and Human Resources (EHR). In EHR, she led NSF's mission to achieve excellence in U.S. science, technology, engineering and mathematics (STEM) education at all levels, in both formal and informal settings.

From 1992 to 1996, she served as the first Assistant Director for the Social, Behavioral, and Economic Sciences (SBE) directorate. Marrett earned NSF's Distinguished Service Award for her groundbreaking leadership of the new directorate.

From 2001 to 2007, Marrett was the University of Wisconsin System's Senior Vice President for Academic Affairs. She also served concurrently as Professor of Sociology at the University of Wisconsin-Madison. Before joining the University of Wisconsin, she was the Senior Vice Chancellor for Academic Affairs and Provost at the University of Massachusetts-Amherst.

Marrett holds a Bachelor of Arts from Virginia Union University, a Master of Arts and a doctorate from the University of Wisconsin-Madison, all in Sociology. She received an honorary doctorate from Wake Forest University in 1996, and was elected a fellow of the American Academy of Arts and Sciences in 1998 and the American Association for the Advancement of Science in 1996. In May 2011, Virginia Union University awarded Marrett an honorary degree as a distinguished alumna.

Chairman BUCSHON. Thank you for your testimony.
I now recognize Dr. Arvizu for five minutes to present his testimony.

**THE HONORABLE DAN ARVIZU, CHAIRMAN,
NATIONAL SCIENCE BOARD**

Dr. ARVIZU. Thank you, Chairman Bucshon, Ranking Member Lipinski, and Members of the Subcommittee. I appreciate this opportunity to speak with you today in support of the National Science Foundation's Fiscal Year 2014 budget. I am Dan Arvizu, Chairman of the National Science Board and Director and Chief Executive of the Department of Energy's National Renewable Energy Laboratory, and with your concurrence I submit my written record, testimony to the record, please.

Before I go on with my testimony I would like to comment on the recent leadership transition here at the NSF. Dr. Subra Suresh, who many of you know, an extraordinary leader, will be missed, but I wanted to also acknowledge that Dr. Cora Marrett has more than capably managed a very smooth transition and continues the strong working relationship both with the Board and the NSF Senior Management. And I have worked closely with Cora now for more than nine years, and I believe her experience and dedication to the Foundation will serve the Nation well.

Mr. Chairman, on behalf of the 25-member National Science Board and the engineering and science and education communities that we represent, I would like to thank the Members of this Subcommittee for their longstanding support of the National Science Foundation. My colleagues on the Board and I do not take this continued support for granted, and our top priority is to provide the strong governance, proper stewardship of this most-important taxpayer investment.

For over 60 years NSF has seeded our Nation's innovation ecosystem by funding the transformative research that underpins long-term scientific and technological progress. With the support of Congress NSF has always focused on funding the best science through a rigorous merit-review system and by encouraging scientists and engineers to submit their most innovative proposals.

Although businesses fund over 60 percent of total R&D in the U.S., only five percent of that goes to basic research. Here the Federal Government plays a critical, complementary role accounting for more than half of all the basic research in this country. This is especially true for knowledge in technology-intensive or KTI industries that produce 1/4 of the U.S. GDP and employ about 20 million U.S. workers with very high-paying jobs.

The NSF 2014 budget request reflects a strategic commitment to supporting the best basic research, economic growth, job creation through innovation, and globally-competitive science and engineering workforce. The Board believes that the priorities in this proposal reflect a clear commitment to investments that strengthen our Nation for the long term.

I would particularly ask for your support for full funding for the NSF's Agency Operation and Award Management Account. I note that although the number of proposals received at NSF has increased over 60 percent in the past decade, the Foundation still re-

plies to roughly 78 percent of those within the first 6 months of having received them, which exceeds the goals that we have set for ourselves. The proposed increase would help NSF process an increasing number of proposals in a way that protects taxpayer dollars while keeping our overhead rate at the very lean six percent that Dr. Marrett mentioned.

I will refer you to more details in my written testimony for more of the other things that I would like to say, but I would like to take this opportunity to briefly comment on the Fiscal Year 2013 Continuing Resolution. In that bill the bill restricts the NSF on what it could fund in political science. Well, NSF and the National Science Board will fully will comply with the law, and I would like you to understand that that is important to all of us. I would like to also raise concerns about how these strictures could undermine the Merit Review Process and the progress of science.

Although we recognize that it is Congress' responsibility to set funding priorities and we are clearly very attentive to that, the Board is unanimous and believes very strongly that legislatively-imposing restrictions on a class of research can run significant risks in not serving the national interest. The Foundation's Merit Review Policies which are emulated internationally hinge on being open to receive the best scientific ideas, having those ideas judged by independent experts, and assessed the soundness and the promise of what is proposed and make decisions based on potential scientific and societal value. To cut a whole class of science from consideration could have significant, unanticipated consequences.

For example, when NSF funded Elinor Ostrom's work, which I know many of you are aware of, on common property, it was not expected that her findings would challenge conventional wisdom, and her research concluded that common resources is sometimes best managed by not regulating them. I think maybe that is something that we all appreciate. Nor was it anticipated that this political scientist would eventually win the Nobel Prize in economics.

In closing, Mr. Chairman, I would like to, again, thank the Subcommittee for their leadership on science and engineering issues. We recognize the fiscal responsibilities confronting the Committee and Congress, and we pledge to work closely with the Director to set priorities. But even in the time of severe constraints, the Board believes that investments in science and technology capabilities, including our S&E workforce, are essential to our Nation's long-term prosperity and security.

So thank you for the opportunity to testify, and I look forward to your questions. That concludes my report.

[The prepared statement of Dr. Arvizu follows:]



**Testimony of
Dr. Dan E. Arvizu, Chairman
National Science Board**

**Before the Subcommittee on Research
House Committee on Science, Space, and Technology
April 17, 2013**

Chairman Bucshon, Ranking Member Lipinski, and members of the Subcommittee, I appreciate the opportunity to speak with you today in support of the National Science Foundation's budget request for FY 2014. I am Dan Arvizu, Chairman of the National Science Board and Director and Chief Executive of the Department of Energy's National Renewable Energy Laboratory.

Before beginning my testimony, I would like to take a moment to comment on the recent leadership transition at NSF. Dr. Subra Suresh provided extraordinary vision and leadership during his tenure as Director, notably with his engagement and collaboration with the international community and his interest in ensuring that NSF-sponsored science results find its way more quickly into the marketplace.

Although Subra will be missed, Dr. Cora Marrett has capably managed a smooth transition and continues the strong working relationship between the Board and the NSF senior management team. I have worked closely with Cora throughout my time on the Board, and I want to express my confidence and admiration for her leadership. As you know, all agencies are facing difficult choices. Cora's long experience with and dedication to the Foundation and the collaborative relationship she has built with the Board will serve the Foundation and the Nation well during this time.

Introduction

On behalf of the National Science Board, and the science, engineering, and education communities which we represent, I'd like to thank members of the Subcommittee for your continuing support of the National Science Foundation. I realize that Members of Congress need to balance many national needs and priorities, but I have been heartened that Congress generally, and this Committee in particular, have provided long-standing support for the NSF investments in basic research and education across all fields of science and engineering. My colleagues on

the Board and I do not take your continued support for granted, and we consider our role to provide strong governance and proper stewardship of these taxpayer dollars our top priority.

For over 60 years, NSF has seeded our Nation's innovation ecosystem by funding transformative research projects across all fields of science and engineering. The knowledge and understanding from this research has served as the bedrock for innovation that has fueled significant economic growth, improved the quality of life for our citizens, and strengthened our national security.

More than any other agency, NSF helps advance the basic research that underpins long-term scientific and technological progress. With the support of Congress, NSF has always focused on funding the best science through a rigorous merit review system and by encouraging scientists and engineers. That's why many other nations are trying to emulate the NSF. Our integration with the community is also part of the reason that NSF only has about 6 percent overhead. We rely on scientists and engineers to serve on our advisory committees and on review panels.

Although returns on investments in basic research are unpredictable, and may not be realized for decades, this research produces the discoveries that feed into private sector innovations. Over 60 percent of Research and Development or R&D in the U.S. is funded by the business sector, but businesses naturally focus most of their investments on development or applied research, with only about 5 percent going towards basic research. Here the Federal Government plays a critical, complementary role, accounting for more than half of all U.S. basic research funding. Within the U.S. science and engineering enterprise, basic research is the "seed corn" for technological application, development, and future innovation, creating a transformative knowledge base upon which the private sector and others can draw.

Though it provides the majority of our Nation's R&D funding, private sector investment can be volatile: following the two most recent recessions R&D investment by businesses has declined. Indeed, following the latest recession, total U.S. R&D spending declined in 2009 for only the second time since 1953, primarily due to the drop in business R&D. Businesses also shifted their investments away from early stage, higher-risk research. This underscores the vital importance of strong, sustained, and predictable Federal support for R&D, particularly the basic research that the private sector is unlikely to fund.

Within the business sector, knowledge- and technology-intensive—or KTI—industries are particularly important. Globally, these industries produce about 30 percent of world GDP. In the U.S., commercial KTI industries comprise one quarter of U.S. GDP and fund three quarters of US business R&D. They employ about 20 million U.S. workers in high paying jobs, and KTI industries report a higher rate of innovation compared to other industries. Although the U.S. is the world leader in share of global value added output, our share is declining as global competition increases. For example, in 1998, China's share of value added output in the high-technology manufacturing sector was 3 percent; in 2010 it increased to 19 percent. As other countries grow their R&D capacity by making strategic investments in areas such as R&D

infrastructure and higher education, America must not only keep pace, but we must reaffirm our commitment to remain the global leader.

The U.S. science and engineering (S&E) enterprise - and our Nation's global competitiveness - rely on the combined health of all its components. When businesses scale back investments during economic downturns, if Federal Government support is unpredictable or declines or our human capital needs are not met through a robust education system, then the whole enterprise suffers with reverberations that stretch well into the future. Our Nation has benefited from the foresight of policymakers and the public in recognizing the long-term value of basic S&E research, and I again thank you for your recognition and support for this key element of our Nation's investment portfolio.

FY 2014 Budget Request

The National Science Foundation's FY 2014 Budget Request reflects a strategic commitment to supporting the best basic research that leads to economic growth, job creation through emerging technologies, and a globally competitive science and engineering workforce. The Request totals \$7.625 billion, an increase of \$592.69 million over the FY 2012 enacted levels. It is the result of rigorous prioritization of activities across the Foundation, and contains almost \$40 million in specific cuts, consolidations, and reductions. This request includes support for research in the social, behavioral, and economic sciences, which the Board endorses as necessary to fulfill NSF's mission to advance the national health, prosperity, and welfare, and to secure the national defense. The requested increase for the Social, Behavioral and Economic Sciences Directorate is \$18 million, or 7.1 percent. The Board fully endorses this Request to ensure that basic research and solutions to societal issues build upon the best multidisciplinary science.

The agency and Administration priorities in this proposal reflect a clear commitment to investments that will strengthen our economy over the long-term. I will point out that the vast majority of the proposed increases are in the Research and Related Activities (R&RA) account, which is necessary and appropriate given decreases in private sector R&D and industry's continuing shift toward development. I would particularly highlight investments in "Big Data," cyberinfrastructure, cybersecurity, clean energy, and advanced materials and manufacturing as programs that I believe will bolster long-term economic growth.

I will also highlight the Foundation's Agency Operations and Award Management account, also known as the AOAM account. This account covers NSF's scientific, professional, and administrative workforce; the physical and technological infrastructure necessary for a productive, safe and secure work environment; and the essential business operations critical to managing NSF's administrative processes and providing high-quality customer service. The proposed increase of \$3 million, or 1 percent, would give NSF support to process the 53,000 proposals we project for FY 2014, up from 48,600 in FY 2012. To sustain the Foundation's

excellent management of taxpayer dollars, the Board urges full funding for NSF's AOAM account.

For the National Science Board, we are requesting \$4.47 million, an increase of \$30,000 or 0.7 percent, which will allow the Board to meet its responsibility to oversee the Foundation's performance and fiscal integrity and to work with the Director to ensure that NSF capitalizes on the opportunities continually arising from the expanding frontiers of scientific knowledge. The Board also works with the agency's Office of the Inspector General to ensure American taxpayers receive the best scientific research in the Nation in return for their investments.

Science, Technology, Engineering, and Math Education

Education that ensures a strong future Science, Technology, Engineering and Mathematics (STEM) workforce is core to the mission of NSF, and this budget request reflects this priority. This budget will enable NSF programs to fund basic research to inform future effective curriculum and instructional practices. It will also enable significant efforts to deploy and evaluate evidence-based STEM education innovations through the new CAUSE program (Catalyzing Advances in Undergraduate STEM Education). At this point, the national dialogue on STEM education at all levels is focusing on the desire to find and deploy the best evidence-based approaches. NSF research is pivotal to these aspirations. The Board strongly urges continued support for research at NSF and for Education and Human Resources at NSF, to enable the Foundation to continue and improve upon this linchpin role.

In the past year, the Board has engaged with the Foundation's efforts to fully integrate its education mission across the agency and to ensure that science across the Foundation is used to enhance STEM education. All directorates, not just the Directorate for Education and Human Resources, are engaged and devoting attention and resources to STEM education in many ways, including involving them in cutting edge research fields through Research Experiences for Undergraduates (REU) sites, as recommended by PCAST's *Engage to Excel* report, and involving students as assistants and collaborators in almost every research project undertaken.

At the graduate level, NSF's well-regarded Graduate Research Fellowships (GRFs) continue to support the best young minds in the Nation to embark on science careers. The Board is pleased that the GRF program was expanded this year to include competitive international travel allowances for GRF recipients to undertake research collaborations with scientists abroad. As science rapidly globalizes, these new Graduate Research Opportunities Worldwide (GROW) will ensure that our next generation of scientists is involved, connected and in the lead. The proposed new budget will enable NSF to *further* expand and extend its GRFs and other traineeship awards to ensure an even stronger future scientific workforce.

Major Multi-User Facilities

Two areas in this budget proposal deserve special mention in my testimony because they have been the subject of considerable Board time and attention.

The first is the U.S. Antarctic Program, known as the USAP. The Foundation's responsibilities in Antarctica go far beyond its traditional mission of supporting ground-breaking research, and the logistical challenges of operating in the extremes of Antarctic cold demand special oversight. Last year, the Foundation, in conjunction with the White House, and with the support of the Board, undertook a thorough external review of research priorities and Antarctic infrastructure and logistics.

I accompanied Dr. Suresh in November, when he took part in a full committee hearing on the resulting "Blue Ribbon Panel" report on *Achieving Fiscal and Logistical Efficiency While Supporting Sound Science*. The Board, through its Committee on Programs and Plans, has carefully monitored the progress of both the review and NSF's response. I am pleased to report that significant steps toward implementing suggested recommendations have been taken, and that the Board has formally endorsed the Foundation's official response to this review.

This budget request will help the Foundation and the Board continue to seek efficiencies in the Antarctic and to pursue creative approaches to meeting USAP infrastructure needs. In addition to streamlining operations, the \$22 million requested would help NSF plan and execute more effective observational approaches to Antarctic science.

The second area that has commanded special Board attention during the past few years is the NSF portfolio of large facilities. The FY 2014 request seeks funding to continue construction of four Major Research Equipment and Facilities Construction (MREFC) projects and to begin construction of the Large Synoptic Survey Telescope (LSST). The requested amount reflects a slight increase over last year's MREFC funding level. I would note that predictable funding levels in this account are critical to keeping these projects on budget.

I assure the Subcommittee that the Board conducts careful reviews of facilities. Although each and every one of these projects has grown out of a lengthy science-driven prioritization process, and includes the Foundation's internal review boards, Large Facilities Office, and MREFC Panel which scrutinizes plans and budgets every step of the way, approval of these projects ultimately comes from the Board. The Board assessed and approved the LSST proposal almost a year ago, prior to its inclusion in this budget request. We review each large award that goes to construct or operate these facilities, and we spend considerable time evaluating the facilities portfolio as a whole. In fact, we have a subcommittee of the Board devoted entirely to assessing and reviewing our facilities and the Foundation's governing processes.

The Board has been responsible for advancing our current policy to recompetete management of long-lived facilities, and has been working with the Foundation to ensure that NSF's investments

in facilities are balanced with our mission to advance the progress of science. And the Board is not alone in rigorously reviewing these large - but critical - investments. The Director's Office has recently completed its own comprehensive review of large research facilities, and has identified a number of actions that address specific Inspector General concerns and will help NSF improve planning and oversight for large facilities.

I would be remiss if I did not mention one particularly impressive example of NSF's determination to responsibly manage its facilities portfolio. The Astronomy community has worked with NSF on a comprehensive review of its existing facilities and scientific priorities. This review resulted in recommendations to divest some highly-successful, long-running facilities. The Board only felt comfortable including LSST in this year's budget request because the Astronomy Division and community have embraced this kind of strategic, responsible planning.

Selected National Science Board Activities

As part of NSF's policy-setting process and in its role as an advisor to Congress and the President on science and engineering issues, the Board identifies important or emerging topics for detailed examination. Many of these are identified through our work on the statutorily mandated biennial *Science and Engineering Indicators* report to Congress and the President. I would like to briefly mention three of our recent and ongoing inquiries.

Science and Engineering Indicators

As you know, our Nation's research universities are the best in the world and are vital to the U.S. S&E enterprise. Several years ago, the Board identified a new concern about declines in state funding for our flagship public research universities. These universities produce a large share of our undergraduate and graduate degree holders. Research universities are particularly important because they provide students with access to an affordable, quality education and opportunities for world-class research experiences. Many states also expect them to produce local and regional economic benefits by seeding new startups and providing local businesses access to highly skilled graduates.

The Board's response to these trends was two-fold: First, we included additional reliable, policy-neutral data and trends for these universities in the 2012 edition of *Science and Engineering Indicators*. We plan to enhance our coverage of this topic in future editions of *Indicators* as new data become available to provide you and other interested stakeholders with the best available information on these vital institutions.

Second, we explored these trends and their implications further in our 2012 policy companion report to *Indicators*, entitled *Diminishing Funding and Rising Expectations: Trends and*

Challenges for Public Research Universities. This report examined the health and competitiveness of our flagship public research universities, highlighting the 20 percent decline nationally over the past decade in per student state funding and the additional challenges posed by rising enrollment and costs. Given that these data are particularly relevant to state-level policymakers, in addition to the national data, we provided state-by-state funding and enrollment data for the past 20 years.

Administrative Burdens

In 2009 Congress requested that the National Academies provide a follow-up report to *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* that would more closely examine the health and competitiveness of the nation's research universities. Among the findings of the 2012 follow-up report, *Research Universities and the Future of America: Ten Breakthrough Actions Vital to Our Nation's Prosperity and Security*, was that "the problem of excessive regulatory burdens ... puts a drag on the efficiency of all university research" - potentially costing "billions of dollars over the next decade." The report recommended that Federal agencies "reduce or eliminate regulations that increase administrative costs, impede research productivity, and deflect creative energy without substantially improving the research environment," and that they harmonize regulations and reporting requirements across agencies.

Congress, in response to the NRC report, held hearings last June. Among the challenges noted by representatives from the Nation's research universities testifying at the hearing were the "increasing numbers and complexity of Federal regulations" that "consume increasing amounts of time and money." In October, Representative Mo Brooks, former Chairman of this subcommittee, requested that the Government Accountability Office conduct a review of current regulations and reporting requirements imposed on research universities.

The Board shares the concern that some administrative tasks may unnecessarily be consuming taxpayer dollars and time that our nation's scientists, engineers, and educators could otherwise devote to the federally sponsored research. Many of our members have experienced, over their careers, increasing requirements as both researchers and administrators. We are also aware of the impact administrative compliance has on NSF's program officers. As a result, the Board created a Task Force on Administrative Burdens in December, and charged it with assessing current requirements on Federally-supported researchers, and offering recommendations where appropriate on relieving the administrative workload. We are mindful that many requirements have been created for proper stewardship, and we hope that this effort, particularly as a complement to ongoing initiatives from the Office of Management and Budget, will help make the Federal research enterprise more efficient and productive.

The Task Force will produce a report of its findings and actionable items for reducing administrative work associated with Federal awards thus increasing efficiency and time spent on research later this year.

Merit Review

Another priority for the Board has been oversight of the Foundation's Merit Review Criteria. The two Criteria, "Intellectual Merit" and "Broader Impacts" are the backbone of the Foundation, shaping the peer review process so that NSF funds the highest quality projects, those with the potential to advance, if not transform, the frontiers of knowledge and which have the potential to advance societal goals broadly.

As you know, the final FY 13 Continuing Resolution restricted what NSF could fund in political science. The NSF and the National Science Board will fully comply with the law, however we would like to raise concerns about how these strictures can undermine the merit review process and the progress of science. While we understand that it is Congress's responsibility to set spending priorities, the Board believes that legislatively imposing restrictions on a class of research will not serve the national interest.

The National Science Board and NSF's merit review policies, which are lauded and emulated internationally, recognize that it is crucial to be open to receive the best scientific ideas, to have those ideas judged by experts who can assess the soundness and promise of what is proposed, and to make decisions based on potential scientific and societal value. To cut whole classes of science from consideration can have significant unanticipated consequences. For example, when NSF funded Elinor Ostrom's work on common property, it was not anticipated that her findings would challenge the conventional wisdom that common property is poorly managed and should be regulated or that this Political Scientist would win the Nobel Prize in Economics.

At the end of 2011, building on Congressional direction in the *America COMPETES Reauthorization Act of 2010* and substantial community input, the NSB Task Force on Merit Review delivered its report, *NSF's Merit Review Criteria: Review and Revisions*. This report reiterated NSB's commitment to the principle that all NSF projects should be of the highest quality and have the potential to advance the frontiers of knowledge, and to the concept that, in the aggregate, NSF projects should advance societal goals.

Although the report recommended that the two Merit Review Criteria remain Intellectual Merit and Broader Impacts, it attempted to define more clearly the two Criteria to help the NSF community better understand each and how they interrelate. During the past year, the Foundation developed specific policies based on the NSB guidance, and they were implemented on January 14th of this year.

The Board also has a longstanding policy of requesting that the NSF Director submit an annual report on the NSF merit review process. This report gives NSB a long-term perspective on the merit-based awards that allow NSF to achieve its unique mission, and we consider it an important tool for ensuring the health of the Foundation. I want to share a few key observations from the last report, which is based on FY 2011 data. First, as I mentioned before, the number of proposals received by NSF has increased over 60 percent in the past decade, and now surpasses 50,000 per year. Despite this increase, the Foundation still replies to over 70 percent (78 percent in FY 2011) of proposals within 6 months of receipt, exceeding our goal.

But the increased numbers of proposals has caused a persistently declining funding rate. In FY 2011, 22 percent of proposals were funded, and in FY 2012, as detailed in this budget proposal, the Foundation estimates that this will fall to 21 percent. In some Divisions it is significantly lower. Although the *American Recovery and Reinvestment Act* resulted in increased funding rates in FY 2009 and 2010, a long-term decline has since resumed. The Board is concerned that these declining success rates may discourage promising researchers from bringing high-risk / high-reward proposals to NSF or even from pursuing a career in science or engineering.

Conclusion

In closing, Mr. Chairman, I would like to again thank the Subcommittee Members for your continued leadership on science and engineering issues and for your support for NSF. The National Science Board recognizes the fiscal realities that you are confronting, and we pledge to work closely with the Director to set priorities and make the sometimes difficult decisions required to obtain the best return on the taxpayers' investment.

Even in a time of severe constraints, the Board believes that productive spending in support of innovation contributes to the economy and the creation of jobs in the United States. The Foundation's long history of expanding the frontiers of knowledge has paid enormous dividends over the past several decades. Our global competitors are increasing their commitments to basic research and STEM education, and we believe that preserving the Foundation's role in supporting these areas is critical.

As you weigh competing priorities, the Board hopes that you will keep in mind how investments in our national science and technology capabilities - including our S&E workforce - are essential to our Nation's long-term prosperity and security. The Board supports the President's FY 2014 Budget Request for the National Science Foundation because we believe, over the long-term, that these investments will lead to economic growth and an ever-improving quality of life for our country.

Thank you for the opportunity to testify.

Dan E. Arvizu

Director and Chief Executive
National Renewable Energy Laboratory

Biography

Dr. Dan Arvizu has been the Director and Chief Executive of the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory (NREL) since January 15, 2005. NREL, in Golden, Colorado, is the DOE's primary laboratory for energy efficiency and renewable energy research and development. NREL is operated for DOE by the Alliance for Sustainable Energy, LLC (Alliance). Dr. Arvizu is President of Alliance.

After more than three decades of professional engagement in the clean energy field, Dr. Arvizu has become one of the world's leading experts on renewable energy and sustainable energy. He has briefed Congress numerous times and given state-of-technology presentations and keynote addresses at dozens of national and international conferences. As NREL's Director, he has established and implemented a new institutional strategy to position the lab for higher impact and contributions to national and global energy challenges. During his tenure as lab director, he has overseen an R&D budget with a contract value of over \$2.5B including over \$500M for new infrastructure improvements. NREL's campus is one of the most sustainable energy efficient campuses in the U.S. which includes NREL's Research Support Facility, the largest net zero energy building in the world powered by 2.5 MW of solar photovoltaics.

Presidential Appointments

In 2004, Dr. Arvizu was appointed by President George W. Bush for a six-year term on the National Science Board (NSB) and in 2010 was reappointed by President Barack Obama to a second 6-year term. In 2012, Dr. Arvizu was elected by his peers as Chairman of the NSB, which is the governing board of the National Science Foundation with an annual budget of \$7.5B, and the national science policy advisory body to the President and Congress.

Boards, Panels, and Committees

Dr. Arvizu serves on a number of boards, panels and advisory committees including:

- Stanford Precourt Institute for Energy Advisory Board
- American Council on Renewable Energy Advisory Board
- Singapore Energy International Advisory Panel
- Great Minds in STEM Board of Directors
- Colorado Renewable Energy Authority Board of Directors.

Professional Experience

Prior to joining NREL, Dr. Arvizu was the chief technology officer with CH2M HILL Companies, Ltd. Before joining CH2M he was an executive with Sandia National Laboratories in Albuquerque, New Mexico. He started his career and spent four years at the AT&T Bell Telephone Laboratories.

Education

Dr. Arvizu has a Bachelor of Science degree in mechanical engineering from New Mexico State University and a Master of Science degree and Ph.D. in mechanical engineering from Stanford University.

Chairman BUCSHON. Thank you for your testimony. I thank the witnesses, both the witnesses for their testimony.

Reminding Members that Committee rules limit questioning to 5 minutes.

The Chair at this point will open the round of questions. I recognize myself for five minutes.

Dr. Marrett, I fully support the hypothesis-based data-driven research to better understanding traumatic brain injury, Alzheimer's, epilepsy, autism, and a whole host of other brain-related ailments. It is very important research as a medical professional.

However, I am concerned about the lack of focus and clarity in the present BRAIN Initiative, especially as it concerns the NSF. How will we ensure there will be a sufficient focus going forward and that we are not just fishing around for ideas?

Dr. MARRETT. Thank you for the question, and in fact, we are more than willing to get back with more details because this happens to fit quite well into what was already on the NSF agenda. We have been investing in neuro and cognitive science for some time, gave a presentation to the Science Board to indicate the directions that we have in mind, and thus, what we intend to do in connection with the BRAIN Initiative will follow through on what the program of research already has been at NSF.

So for us it is a wonderful way for being able to articulate, and as you know quite well, the idea of being able to address questions about Alzheimer's, autism, those are far into the future. We do not have the models, the tools right now to get to that level. The amount of fundamental work that is required is something that we are investing in. It is not a matter then for us of a fishing expedition. But as I said, we are more than willing to provide you details on what the NSF portfolio will be with reference to the BRAIN Initiative.

Chairman BUCSHON. Thank you, and one of the researchers at Purdue University I just met with is doing research on football helmets, which has been on the front page recently as it relates to chronic traumatic brain injury funded by the NSF.

The next question. In your budget you have 372 million being spent on clean energy research. This includes research related to smart grid, energy use, energy efficiency. How are you working with the DOE Office of Science to ensure that we don't duplicate research with our funding efforts? And are you encouraging collaboration between the appropriate offices at NSF and DOE to make sure that this doesn't happen?

Dr. MARRETT. We work very closely with DOE—with several offices from the Office of Science at DOE—and support of CERN in Switzerland with the Office of High Energy Physics. The connections are very deep that we have. We pay a lot of attention to the matters of ensuring that there isn't duplication. And in part, why that is not all that difficult is, let me again note, our investments at the very fundamental and basic levels will mean that we need the connections with other agencies, other places if many of the ideas and the results are going to move into the larger sector. So DOE is a strong partner in so many of the things that we do including the area of clean energy.

Chairman BUCSHON. Thank you. Dr. Arvizu, can you talk to us a little bit about the role that private industry plays in terms of creating and retaining science and engineering jobs versus the types of positions funded with Federal dollars? How do we ensure the science and engineering workforce continues to grow, perhaps better focusing this responsibility on the private sector?

Dr. ARVIZU. Yes. Thank you, Mr. Chairman, for that question. I think it is very clear that one of the long-term benefits that you get from funding basic research is the societal benefit that ultimately finds its way into service for the public good.

There is a whole ecosystem of what it takes to get from basic research all the way out to commercial products and hopefully things that are making a difference in the way we produce things and consume things.

There is a, in many respects, a series of barriers that sometimes mitigate the quick adoption of technology. So in the case of the work that NSF does with I-Corps, for instance, there we are trying to help researchers find those pathways which are typically more driven by the private sector. Through public private partnerships, many kinds of state incubators, university research programs, where there actually are mechanisms already in place that the private sector would fund access to venture capital, those kinds of things, that help that technology move more quickly.

And the work, I think, within the government's role and specifically for the National Science Foundation, is to help facilitate that. I think we don't want to lose track of the idea that the mission objective of NSF is really to do fundamental work, to do basic discovery science.

Chairman BUCSHON. Thank you. I now recognize Mr. Lipinski for five minutes for questions.

Mr. LIPINSKI. Thank you, Mr. Chairman. I am going to surprise everyone, first of all, by not asking a question on I-Corps right now. If you were here this morning, you know I talked about that, I talked about it in my opening statement, but let's go to talking about funding for social, behavioral and economic sciences, and of course, I have to disclose I do have a Ph.D. in political science and at one time had an NSF grant, a very, very small one, when I was in grad school.

But as Dr. Arvizu had mentioned about the amendment in the House, well, the amendment, let's say we did have an amendment in the House defunding for political science research, which it didn't wind up going through but then the Senate version that limited the grants to those promoting national security, economic interests. We had the majority leader of the House talk about, you know, questioning the funding of social sciences, and Dr. Arvizu, you pointed out Elinor Ostrom, political scientist, who got NSF funding, received NSF funding, won the Nobel Prize. I could point out NSF-funded research by Al Roth and others who did research in the kidney exchange matching program that led to over 125 kidney transplants since 2007, research that, you know, directly saved lives, and he received the 2012 Nobel Prize in economics for his work.

So there is a lot of social science work that we could talk about that does have an impact, a direct impact on people's lives. So I

want to give Dr. Marrett the opportunity to talk about the value of social science research, why the NSF funds it, and the other thing, first I want you to start off by telling us what percentage of NSF funding goes into the SBE Directorate.

So, Dr. Marrett.

Dr. MARRETT. All right. I will get you the exact percentage, but of the \$7 billion budget for NSF, for the social, behavioral, economic, and sciences it is just over \$272 million. So this is not the large fraction of the support in these fields.

Now, when I think about the social, behavioral, economic, and sciences, let me start with our notion of what is important when we think of science. Science, we especially emphasize, has to do with using an approach that is systematic, orderly, it is theoretically driven, and it is the findings—there is replicability. So it is more in the approach that one takes than the phenomena that would be considered. That means that you can apply this approach to any number of areas, fields, questions, and that is the way in which we say then the social, behavioral, and economic sciences follow the same model that one sees for the physical sciences, for the life sciences, for engineering at the National Science Foundation.

Now, what about the investments? It is possible to talk about the particular kinds of projects as we often do, but it is also very important of the link to this other concern we have, and that is attracting people's interest, attracting young people often—even though for the National Science Foundation and for decision makers, we often think about science and engineering being important for the innovation in the Nation. But I have said on more than one occasion, I can't think of very many 10-year-olds who will say I want to be a scientist or engineer so I can innovate for the Nation. No. It is more about the attractiveness of the kinds of things they have a chance to explore, and that exploration that can take place, we call it the chance for the authentic experiences, the authentic experiences can occur through any number of realms, and that is where we have discovered that the social behavioral sciences, along with, again, the life sciences, physical sciences, become important means through which any number of young people, older people as well, get to understand something about the way in which processes occur and can question, can understand the dynamics that can be at play.

So that is probably a longer way around to what was a very interesting question about what we have in mind, and that is why we remain so committed to the notion of we want to see that the best work is done in all fields because of the consequences that can be there, yes, for the problems the Nation faces, but also for the curiosity that we often have as human beings about the worlds we inhabit, the worlds that we create.

Mr. LIPINSKI. Well, very quickly, I am out of time, thank you, Dr. Marrett. I came from an engineering background, had a couple degrees in engineering before I went into political science, but I understand that there are issues. We were just talking about—had two bills on the Floor yesterday. One was the Cyber Security Enhancement Act that I did with Mr. McCaul, and one of the important things to look at is, yes, we think about this as a technological issue, but one of the biggest issues in this in cyber security is inter-

net hygiene, computer hygiene. That is what people are doing, the mistakes people make. Humans are the weakest link in there, and that is getting into the social sciences and trying to figure out what—how we shore up security when it comes to human beings which could unravel the whole, whatever we do on the technological side.

So with that, I will yield back.

Chairman BUCSHON. Thank you. I now recognize Mr. Stockman for five minutes.

Mr. STOCKMAN. I think you are going to find generally on both sides of the aisle we support you, and I think what we are trying to get at is when we go back to our home districts, I know you had a disagreement with some of the CR, but we have to go back, and we have to present what you put forth to our constituents. Sometimes when these 10,000 grants, some of these anomalies come up, it is a difficult challenge to present and defend, especially in these tight budgets.

My father, I took care of him for eight years with Alzheimer's Disease, and he died. So when the President announced his initiative, I was actually fairly excited until I heard on April 5 on NPR, and let me quote you here, Susan Fitzpatrick, who runs the leading foundation that finances brain research, it is called the James McDowell Foundation. Are you both aware of that?

And she says, "[t]o be quite honest, I am befuddled, I was befuddled, I don't understand what the President is talking about." This is the lead person, and so I guess what I am asking you is if this goes out, there are 20 million people listening to it, and I go and have a town hall meeting, and I am sympathetic to your views, and I have to defend what you are doing, and yet we have someone that is the lead scientist saying you are doing the wrong thing, I am stuck in the middle. I am your messenger.

I guess what I want to know is—go ahead. I can tell you are wanting to go.

Dr. MARRETT. No. It is exactly why we want the kind of dialogue, because you are right, and if we have not been clear enough, you keep pushing us for that clarity. I heard that same NPR account and thought immediately I was going to turn to my colleague, Dan Arvizu, because the President of the McDonnell Foundation was a former colleague of his on the National Science Board.

So I think in that case that was our failure probably to have included the colleague as the developments were unfolding. And knowing him I am sure that he would not take the position that this is completely unreasonable, but it is a matter of trying to bring a number of people to the table.

Dan?

Dr. ARVIZU. Yeah, and I would just add to that, you know, one thing that I think in terms of how you respond or otherwise communicate to constituents who are anxious to understand who does, you know, how are the decisions being made and what process are you using, one thing I will say is that the process of going through merit-based peer review and trying to understand what things to fund and what—how to set priorities is actually evolving as things, as we learn more, as we gain more understanding, as we gain more insights.

Everything is changing in a fairly rapid rate. I think there is no substitute for having the best minds come together and debate, discuss, otherwise disagree but ultimately come up with a process that serves the Nation and the country to move the societal benefits.

So we are trying to do that, and we are trying to improve. Certainly room for improvement in all the processes we have, but it is as Dr. Marrett has said, the gold standard so far.

Mr. STOCKMAN. But in that NPR story they said it was more of a PR stunt. Would you—have you reached out to these folks and talked to them about—I mean, that is a pretty big disagreement with the President.

Dr. MARRETT. Yes. As a matter of fact, we are going to send you far more details. One of my colleagues sitting here with me, John Wingfield, who is the Assistant Director for the Biological Sciences, has the lead for the Foundation in articulating, presenting what we have in our program and would welcome every opportunity imaginable to be able to communicate that, to convey, because as we said, we know we receive funding from the public. We have to be able to explain, to listen, to be able to share with that public. So we do want to get to you more of those details.

Mr. STOCKMAN. Yeah. I would actually, if you could write up how, you know, how it is decided, the kind of formulation, and how you guys go through the process. That would be helpful to us, but—and I don't know if there are some studies we can point out there which back in my district I would have a hard time explaining, so I would appreciate the formula and the mathematics or however it is structured so that I can explain it to my own constituents.

And with that I yield back the balance of my time, Mr. Chairman.

Chairman BUCSHON. Thank you. I now recognize Dr. Bera.

Mr. BERA. Thank you, Mr. Chairman. Thank you, Ranking Member. Thank you, Dr. Marrett and Dr. Arvizu.

You know, as a biological sciences major, I spent a lot of time doing basic research, and as a physician I spent a lot of time in medical school doing research and as a faculty member and a former associate dean, have mentored many medical students that have gone through the research process.

So I understand that, you know, part of research is you do experiments. You don't always know what the expected outcome is going to be, and it often is that the biggest breakthroughs are the unexpected discoveries. And those clearly have, you know, we can go back through our history and look at a lot of those unintended discoveries that have really propelled our economy forward and our science forward.

I appreciate the fact that we have to be very conscious of how we are spending the taxpayer's resources. We have to be conscious of the debt and the deficit so we do have the resources to invest and make strategic investments, but it can't just be a discussion of cutting versus raising revenue. It also has to be a discussion of where can we get the best return on our investment, and throughout NSF, the Science Foundation's history, we see these discoveries, you know. I will quote a simple example.

You know, in the 1990s the NSF led a multiagency project for digital library initiative. You know, there were two young Stanford University grad students that participated in this. One, Sergey Brin, was funded by an NSF fellowship. I don't have—history is going to tell you what that research led to. It is a company called Google that is now worth over \$200 billion and employs over 30,000 individuals. It is transformed how we live.

You know, there are countless examples of those unexpected discoveries that have spurred innovation and moved us forward. You know, we can look at advanced manufacturing. You know, it was NSF-funded research that produced one of the first 3D printers. You know, I had, recently had the ability to go visit my alma mater at the University of California Irvine and visit the engineering department, and it is amazing what they can do now, and the applications of the 3D printing and the advanced manufacturing is really going to propel us forward, both in my profession as a physician but across the board.

Dr. Marrett or Dr. Arvizu, can you give us a few other examples of areas that NSF has focused tackling some of these challenges for, you know, on the issue of agribusiness, on the issue of, you know, honeybees and so forth?

Dr. MARRETT. The list could be so long I hardly know where to start. We actually produce publications around exactly that. There is a whole process we have used called traces in which you could trace back. Here is a given development and what led to that. So you have seen that a lot in what we have shown in the whole area of cognitive tutors. That started with just some very fundamental work out of cognitive science that continued to be refined, that led finally to this whole notion that it is really—there is the accompanied, there are the things that are done financially out of that about how you improve the whole tutoring process.

We have cited time and again another that started with just some very basic research out of the conceptual notion of game theory that led to the use of the auctions, auctioning the radio spectrum, a process that has brought now billions of dollars to the U.S. Government.

We have then any number of ways in which it is quite possible to have some outcomes you just never anticipated, and as all of the examples show, it usually takes time. So these aren't things that happen all of a sudden, that it is a matter usually of continued investment in areas, but there is no shortage of the kinds of examples, and my colleague is ready to offer some others.

Dr. ARVIZU. I will just give you the short version here. Lots of technology that relates to the internet, web browsers, Doppler radar, magnetic resonance imaging, DNA, fingerprinting, barcodes to name a few. There is a host of others.

Mr. BERA. Well, thank you. We, you know, in order for us to maintain this competitive advantage over the rest of the world, we are the most innovative country in the history of our planet. We have to continue making these investments to make sure we continue to lead the world in innovation, and with that I yield back, Mr. Chairman.

Chairman BUCSHON. Thank you.

I recognize now the Chairman of the full Committee.

Chairman SMITH. Thank you, Mr. Chairman.

Chairman BUCSHON. Chairman Smith.

Chairman SMITH. I don't know if it is been covered or not, but I would like to go back to a subject that I raised in my opening statement, and ask both witnesses if I could for suggestions. Help us come up with a way where we can try to discourage the approval of National Science Foundation grants that don't benefit the American people or our economy or our science discoveries or any of those things that we would all agree upon. And I actually mentioned it this morning at a full Committee meeting with Dr. Holdren, but you have these examples, and I think I have got 50 of them, but the two or three that I recall right now is the grant that was approved to study National Geographic photos of animals from 1988 to 2008. I love National Geographic. I love seeing the photos of animals, but should that study be conducted at taxpayer expense?

The other one was, I think, the labor force in China in the 16th, 17th, and 18th centuries. Is there something we can do to make sure and maybe it is the approval process, maybe it is expressing Congress' sentiments. What can we do to better the approval process so that the American people will agree that their taxpayer dollars are being spent in a worthwhile way?

And that is part of it but—and it is not to deny that almost anything can be justified or have scientific value, but when only one out of every seven grants are being approved, there ought to be a higher standard than the standard that allows proposals like that to be approved. And that is not to say they shouldn't occur. Those studies might well should occur, but it should be on somebody else's dime, perhaps, rather than the taxpayers, and I welcome your comments, Dr. Marrett.

Dr. MARRETT. Yes. I think it is a fascinating question, and it is one that we certainly wrestle with. I would make a distinction, though, between the title of a project and what I think is your basic concern. You asked about the benefits, and as I was explaining earlier, the benefits are not always known when that project is, in fact, being developed. The title then can be very misleading.

I like the example we often use of Google. The initial title for that activity was BackRub. If we had just been looking at titles I have a feeling that there would have been someone saying, what? The National Science Foundation is going to fund something called BackRub.

Chairman SMITH. And that is well and good, and I can appreciate that, but in these cases I have read the several-hundred-word summary of these projects, and that is almost intellectual dishonesty if you are going to study something that you don't describe in two or 300 words. I assume that they meant what they said, but I also don't think you are saying that there aren't proposals that are approved that shouldn't be approved, and I realize they are a very small percentage.

And but that is just it. You don't want them to color the overall process, and if there is a rational, reasonable way to try to eliminate some of these proposals from being approved, I assume that you would support that, and if so, then, what would—how could the process be improved?

Dr. MARRETT. That is what I said. We can come back to you—
Chairman SMITH. Okay.

Dr. MARRETT. —with suggestions and ideas because it is extremely complicated. In the list of projects that have sometimes been cited as having funny titles or a number of other things, you will see a number of them are dissertation topics. They were graduate students, and I can just envision that the reviewers were saying, let's not give up on them. Let's see what might be developed out of that. That is why I am saying it is a complicated process to determine, to ensure that we don't, in many ways, make it difficult for the best ideas to evolve.

The other thing that we are more than willing to do is to have the conversations about how the process, as I have said earlier, how our whole process works, because it is a process in which we make special efforts to try to reach across the best of the experts to try to weigh in on what makes sense for all of what is being developed, but we welcome—

Chairman SMITH. Good. I am glad you admit we can improve the process, and we will follow up on that.

Dr. Arvizu.

Dr. ARVIZU. Yeah, and I will just quickly, just piggyback a little bit on what Dr. Marrett has said. You know, right now we have two criteria; intellectual merit, broadening participation, and the Board conducted a review on those criteria just as recently as last year to think through what are all of the implications of that on the community broadly. How do we justify that the taxpayer, that the U.S. public is getting the best science, the best proposals, transformative research, to ensure that there are not built-in biases that we don't understand.

And so we are very anxious to continue to improve that process, and to the degree there are things that can be done that will help remove perhaps those that fall into that category called questionable, certainly are very open and willing to—

Chairman SMITH. Mr. Chairman, if you will give me another couple of seconds here. I am a little bit over.

Would you all agree to add to the guidelines something along the lines of that any proposal approved would have to directly benefit the American people?

Dr. ARVIZU. So that—that sounds like a great statement. I am—

Chairman SMITH. I am thinking about those I have seen that had to do with people in China. Not that there is anything wrong with that, but I would like—

Dr. ARVIZU. Yeah.

Chairman SMITH. —to direct that—

Dr. ARVIZU. That has more direct benefit. I think the issue and the question really is how do you start down a path of limiting or otherwise rephrasing that criteria so that it catches the things that you want and perhaps eliminates the things that you don't. In that case I think it begins to sound or to us feel like it is compromising the integrity of the basic process.

Chairman SMITH. To say that—let me get this right. To say that National Science Foundation proposals paid for by the American taxpayer, it compromises to say that it should benefit Americans?

Dr. ARVIZU. I wouldn't—certainly not put it that way. I would say that if we have criteria that unduly limits the opportunity for societal benefit to actually be gained by——

Chairman SMITH. But shouldn't they be able to state what those societal benefits are?

Dr. ARVIZU. We should be able to do that, and we believe that the criteria that we have today actually get at that in as robust a way as we know how. Certainly open to——

Chairman SMITH. And how do you explain all those proposals?

Dr. ARVIZU. We are certainly not perfect in a lot of respects, but I am not in a position where I can talk about the specifics.

Dr. MARRETT. I was going to ask would you mind——

Chairman SMITH. Who am I holding up here, Mr. Chairman? Who has questions left besides me?

Chairman BUCSHON. Ms. Lummis.

Chairman SMITH. Okay. I better——

Ms. LUMMIS. And let me yield one of my minutes to you, Mr. Chairman.

Chairman SMITH. Okay. Thank you. Sorry. I hopefully won't use that.

Dr. Marrett, did you want to reply?

Dr. MARRETT. I was simply going to ask would you mind if we— you were asking the Science Board to take a look at exactly that kind of a question. What would it mean to say that the research, that the specific benefits because we already—our funding is to the U.S. group of scientists and engineers.

Chairman SMITH. Yeah.

Dr. MARRETT. So we don't fund the international, and it is always the assumption that the benefits accrue to the U.S. population, but how one would try to formulate that more sharply I think my colleague from the Board is more than willing to say——

Chairman SMITH. So you are open to new——

Dr. MARRETT. —the Board can take that up.

Chairman SMITH. —guidelines. You are open to new guidelines?

Dr. ARVIZU. We are open certainly to continue to evaluate if those guidelines serve the national interest, and I would certainly be open to——

Chairman SMITH. The guidelines don't even say national interest, do they?

Dr. ARVIZU. Yes. I think the Organic Act that formulated the Foundation says in something about the national interest, I believe, and prosperity.

Chairman SMITH. Well, I haven't seen in all the write-ups I have read of these suspect proposals, I have never seen any reference to the national interest.

Dr. ARVIZU. Yeah. The guidelines that we use, I think that the Foundation uses, the two that I mentioned earlier, intellectual merit and broadening participation——

Chairman SMITH. It might be good if those who write the proposals mention that. I would recommend that anyway. Thank you, Mr. Chairman. Thank you for your time, Ms. Lummis, as well.

Chairman BUCSHON. I now yield to Ms. Lummis for her questions.

Ms. LUMMIS. Thank you, Mr. Chairman.

First, Dr. Marrett, just to give you a head's up, my first question is about Clean Energy Initiative, second is about supercomputing, and the third is for Dr. Arvizu about recommendations on regulations that increase administrative costs at research institutes, research universities. Okay. So, Dr. Marrett first.

Does any of the \$372 million requested for Clean Energy Initiatives go to the U.S. Global Change Research Program? Do you know? And if so, how much?

Dr. MARRETT. I can't give you the exact figures, but as you can tell from the budget the U.S. Global Change Research Program is what we call a crosscut in that it is organized through the National Science and Technology Council out of the Office of Science and Technology Policy. So, that means that things are reported in a particular way for that program.

For the Clean Energy Initiative, that is a slightly different formulation that asks agencies what they are actually undertaking with reference to the clean energy. You wanted to know the amount that we funding in the Global Change Research Program. The request for '14 is \$326 million, and that program is to be a comprehensive research program, but I think your other question is a link between that and the Clean Energy, and if my colleagues here don't have the answer for me right now, they will have it in a short time.

Ms. LUMMIS. And I appreciate that. I know that is a very specific question, so if you could follow up with my office on the answer to that question, you know you are your convenience. At your earliest convenience. That would be great, Dr. Marrett.

Now, turning to supercomputing, what portion of your budget deals with supercomputing or maybe I should put it this way. What is the budget for supercomputing?

Dr. MARRETT. Probably the easiest way to describe that is the budget for what is now the Division for Advanced Cyber Infrastructure. Now, that includes—but I would have to modify that a bit because that is not just about supercomputing, that especially moving in recent years to try to ensure that the information infrastructure is going to be what is available and useful for all scientists and engineers. Supercomputing had—some of what was developing was for the very high-end user, and we had other than high-end users, but, again, the exact budget they will give me momentarily.

Ms. LUMMIS. And I appreciate that because I know I am asking really specific questions.

Dr. Arvizu, question for you. I note that there was about a year ago a report called *Research Universities and the Future of America*, and it had in it ten recommendations, one of which, recommendation seven, reads as follows: “[r]educe or eliminate regulations that increase administrative costs, impede research productivity, and deflect creative energy without substantially improving the research environment.”

Can you describe the taskforce work, the taskforce on administrative burdens, and what it is found with respect to unnecessary burdens on research universities?

Dr. ARVIZU. Thank you, Congresswoman Lummis, for that question. That is a topic of great interest to us at the Board, and so we have put together a task force that will focus specifically on try-

ing to understand that which you refer to is our Administrative Burden Task Force. The findings to date are still very, very preliminary. In other words, we have just started the investigations, we have held already some workshops. We will hold more. There are a number of Board members who are very active in the community and are very anxious and interested to get at that, but we will give you a full report on the findings of that taskforce as soon as they come available. Right now it is still in the early stages.

Ms. LUMMIS. Great, and Mr. Chairman, for all three of these questions, which I know were specific, I would be really grateful if you would sort of flag that Congressman Lummis is interested in this, and it would be just really terrific if you would follow up with me certainly when your findings become more solidified rather than preliminary and—because I have a tendency to jump the gun a little bit, and I want to make sure you have time to be really confident in your recommendations.

And, you know, Dr. Marrett, same thing. If you need a little extra time to get back to my office with these or your staff could, that would be just super.

Dr. MARRETT. I will tell you right now for the Advanced Cyberinfrastructure Division that I was describing, the budget is \$221 million, and I only wanted to give that to you now because I failed earlier to thank you for being present at the Wyoming supercomputer opening. Thank you.

Ms. LUMMIS. Well, we are very excited about it as you can well imagine. I just can't even contemplate the number of computations that those computers are capable of making every nanosecond, and the fact that atmospheric research is so important, we are truly excited and committed as a university conglomerate, all of the universities involved in academic research just think that this is an absolutely terrific thing. And we really want to thank the NSF for recognizing the importance of supercomputing and scientific research, particularly atmospheric research.

And when I was my state treasurer, I was on the very, very, frontend of helping fund that center and have toured the Boulder Mother Ship for NCAR, and it is really, really a wonder, an American accomplishment. So kudos to you all. Thank you.

I yield back.

Chairman BUCSHON. Thank you. We are going to go into a second line of questioning, and you are in luck because there is only a few of us left.

And I yield five minutes to myself.

Dr. Marrett, we had a hearing, as you probably know, on open access issues to publically-funded scientific research data, and I see in your NSF budget you have 2.5 million dedicated towards ensuring public access. That is actually a small amount, but there are some significant policy implications with that, I think.

What specifically do you hope to accomplish with this funding, and is \$2.5 million enough to accomplish your goals, and then I will have a follow up.

Dr. MARRETT. Well, thank you. Obviously, \$2.5 million is not enough to ensure public access to the publications that NSF supports and to the data. That is really there for the planning that we must undertake because that is—we have the question of what can

we, in fact, achieve, and we are starting on the publication side. But another reason why there isn't a fully-flushed out proposal yet or plan yet is that all agencies have been asked by the Office of Science and Technology Policy to develop a plan.

So it would be premature to come in at this point with the full details when we are working on the plan for what we will have to submit. We will be developing more, and again, we will be open to giving you the information as it evolves.

Chairman BUCSHON. So the funding is specifically just in the—for the planning stages of—

Dr. MARRETT. That is right.

Chairman BUCSHON. —that. That is great, because I think, you know, as a result of our hearing we found out that—I think it is important if the taxpayers are funding research projects, I think for the taxpayers and the American people to have access to not only the results but now because everything is on computers, the actual data that generated the results so that we can have the ability to duplicate scientific studies and get similar results, which has been a controversial thing for a long time. And part of that has been, I think, is because people haven't had the access to the full data set that has been used by the researcher in the first place.

And so the follow up was probably inaccurate, and we saw that—we see that a lot in my medical profession of cardiac surgery where there have been multiple studies on all kinds of things that seem to contradict each other, but when actually you get into the weeds, they really are very similar or there was a missing piece of information that the follow-up researcher did not have access to.

So thank you for that answer, and I don't have any other questions.

I will now yield to Mr. Lipinski.

Mr. LIPINSKI. Thank you, Mr. Chairman. I want to go back to Chairman, what Chairman Smith was discussing. I just wanted to—maybe it is because I was the author of the NSF Reauthorization Bill last time, but I just wanted to bring up something that we put in there, it is Section 526 of the final bill, the America COMPETES Reauthorization, the Broader Impacts Review Criterion.

And let me just read this here so everyone is aware of this, and we have this on the record. If you look there, under goals, "The Foundation shall apply a broader impacts review criterion to achieve the following goals."

So these are for anyone who is submitting a proposal is supposed to discuss how it meets one or more of these criterion. "One, increase economic competitiveness of the United States, two, development of globally-competitive STEM workforce, three, increase participation of women and under-represented minorities in STEM, four, increased partnerships between academia and industry, five, improved pre-K through 12 STEM education and teacher development, six, improved undergraduate STEM education, seven, increased public scientific literacy, and eight, increased national security." So we have bookend there, increased economic competitiveness and the increased national security there is number eight.

But so right now those are to be considered when any proposal is being reviewed by the NSF. So I just wanted to—I don't think

I really had a question. I wanted to make sure that I brought that out there that this is already—we codified it for the first time in the Reauthorization, which was in the COMPETES Reauthorization back in 2010.

So I just wanted to have that out there for the record. I don't know. There is no need for a comment, but if Dr. Marrett or Dr. Arvizu had anything to add to that, you are welcome to add it. If not, I can just move on.

Dr. MARRETT. I suppose my only comment is since Dr. Arvizu had said the Board would be willing to think about the benefits to the Nation, what the criteria are already, perhaps they don't say a benefit to the U.S., but that is really what they are directed towards. So that is the way I interpret your comments.

Mr. LIPINSKI. That is certainly what we intended and put those specific categories out there.

Dr. ARVIZU. Yeah, and I just want to clarify, and thank you for reading the sub-bullets on each of those two criteria. I think those both found at least in the reviews that we have had to date, been sufficiently robust that we couldn't figure out how to improve on them. Certainly willing to listen to suggestions about how to improve them, but the last review went through this process and looked at it and said that really achieves the results that we were trying to accomplish.

Still, I am open to the idea that there would be opportunities to improve on that, but, again, it is a subject of debate and discussion. The Board is made up of 25 members. Each of them have a different perspective on how to approach scientific and intellectual merit, and I think to a large degree the value that the Board brings is the diversity of opinion, and when they come together and they codify this, and that kind of is the latest position that we take.

Certainly continuous improvement requires that we go back and revisit those on occasion.

Mr. LIPINSKI. And I certainly won't claim that I am perfect and we were perfect in putting this together in 2010, but certainly I think we certainly gave a lot of consideration to this, and if there are suggestions on how this can be improved, I think we should all be open to that.

I think with that I will yield back.

Chairman BUCSHON. Thank you. I would like to say in closing that—thank you for your testimony. It is valuable testimony to the Committee. Also thank the other representatives from the National Science Foundation who are here today, and there is a whole row there and that as the Chairman of the Subcommittee I fully support, obviously, scientific research, and I think that we want to make sure that as the Federal Government we are not short-sighted in our role as it comes—as it relates to funding basic science research. We have had a couple of hearings where people from the private sector that spend quite a bit of money on research did tell us how important the NSF still is and will continue to be when it comes to funding basic science research for the future of our country, and thank you, again, for coming.

I thank the Members of the Committee. The Members of the Committee may have additional questions for you, and they will ask you to respond to those in writing. The record will remain open

for two weeks for additional comments and written questions from the Members.

The witnesses are excused, and the hearing is adjourned. Thank you.

[Whereupon, at 3:36 p.m., the Subcommittee was adjourned.]

Appendix I

ANSWERS TO POST-HEARING QUESTIONS

ANSWERS TO POST-HEARING QUESTIONS

Responses by The Honorable Cora Marrett

**UNITED STATES HOUSE OF REPRESENTATIVES
Committee on Science, Space, and Technology
Subcommittee on Research**

**Hearing on
An Overview of the National Science Foundation Budget for Fiscal Year 2014
April 17, 2013**

**Dr. Cora Marrett, Director (Acting), National Science Foundation
Questions for the Record Submitted by
Larry Bucshon**

National Science Board

Question 1. What are examples of NSF-related policy issues that you and the board currently disagree? Please elaborate.

Answer: The National Science Board and the Director jointly pursue the goals and functions of the NSF. There are no policy issues on which there is significant disagreement.

Research Misconduct

Question 2. The pressure by investigators to obtain research grants will increase, especially in this competitive research funding climate. I believe most investigators will apply for NSF grants with integrity and also conduct their research in a noble manner. However, the number of cases of research misconduct is growing. Do you believe that this situation will get worse with time? If yes, what is behind this growth? Please explain.

Answer: Research misconduct includes fabrication, falsification, and plagiarism. Most of the research misconduct cases addressed by NSF fall into the category of plagiarism. NSF takes seriously all types of research misconduct and takes measures to prevent its occurrence. For example, NSF requires that organizations submitting proposals certify that they have a plan to provide training in ethical research and verify that the students and post-doctoral associates on NSF-funded awards have received the training. Additionally, NSF provides training to its staff and outreach to the research community. Selected NSF funding opportunities include ethics components on the promotion of ethical research, such as Ethics Education in Science and Engineering. Such measures are intended to address the multiple causes of research misconduct.

Clean Energy Research

Question 3. I am concerned that the emphasis on clean energy research may be at the expense of other potentially transformative research. How can we ensure that this will not become the case?

Answer: The National Science Foundation (NSF) funds fundamental potentially transformative research proposals from all disciplines of science and engineering. These proposals may be submitted in response to topical specific solicitations or to any of NSF's fundamental research programs. This structure ensures that NSF supports research in areas the scientific community considers currently promising. Clean energy research is only one general topic within a broad portfolio. The "emphasis" on clean energy research is mainly driven by the *unsolicited* proposals received addressing fundamental science and engineering questions and strong interest in the science and engineering research communities in this general topic area. NSF

partners with the research community through the peer-review process to ensure that the most meritorious, impactful, and potentially transformative research proposals are recommended for funding.

INSPIRE

Question 4. In your NSF budget, you have \$63 Million being devoted to the INSPIRE program. Your testimony states that this investment will strengthen “NSF’s support of interdisciplinary, potentially transformative research by complementing existing efforts.” Which ‘existing efforts’ are you specifically targeting?

Answer: The INSPIRE program comprises proposal opportunities for ideas that are required **both** to be interdisciplinary and to exhibit potentially transformative research (IDR and PTR, respectively). It is complementary to existing efforts in that INSPIRE was created to handle proposals whose:

- Scientific advances lie in great part outside the scope of a single program or discipline, such that substantial funding support from a single distinct program or discipline is unlikely.
- Lines of research explore bold methodologies that are beyond well-established practices in accordance with expected progress in their fields.
- Evaluation through non-standard merit review processes might reveal prospective discoveries hidden at the interfaces of disciplinary boundaries.

Also, although NSF has specific solicitations for IDR or PTR in selected targeted areas of science, INSPIRE complements these since it is open to all areas of science supported by NSF and there are no favored topics. INSPIRE is an experimental activity that will be assessed over the next five years to determine if its various funding opportunities have resulted in support for proposals that normally would not be submitted to NSF.

Cognitive Science and Neuroscience

Question 5. In your NSF Budget request, you have \$14 million going to cognitive science and neuroscience. It seems a big part of this funding will be going towards workshops to identify specific gaps in our current understanding of the brain. Why are you taking this approach? Don’t you think the National Academy of Sciences should commission a study? After all, acting in their capacity as our nation’s main scientific advisory body, aren’t these gaps what they are best tasked to determine? What alternative approaches could be used with this money? How are these proposed workshops going to be productive, with consensus being reached on the scientific framework?

Answer: While some of the enhanced funding will certainly be used productively in workshops—which are important starting points for scientific collaboration and discussion across disciplines and in framing research agendas—most of the funds will not be used for that purpose. NSF is committed to making targeted investments in collaborative science and innovative technologies to accelerate discovery that will revolutionize our understanding of the brain. NSF is uniquely positioned to lead a broad multi-disciplinary effort that brings the imagination of scientists and engineers together to advance a comprehensive understanding of brain structure and function. Progress in this area holds an almost unlimited potential for improving our educational, economic, health, and social institutions and for enhancing the lives of Americans.

The proposed cross-foundation activity responds to a number of societal needs and scientific community challenges. The integration of research in cognitive science and neuroscience across scales has the potential to accelerate scientific discovery and innovation, promote advances in technology, and contribute to improved U.S. economic competitiveness.

In FY 2013, the Cognitive Science and Neuroscience Working Group, with representatives from six NSF directorates, drafted a Dear Colleague Letter (DCL) titled "Accelerating Integrative Research in Neuroscience and Cognitive Science (AIR-NCS)." The intent of this DCL is to direct researchers interested in integrative neuroscience to use existing funding mechanisms (EAGERs, Research Coordination Networks (RCNs), and INSPIRE) to further their scientific endeavors.

In FY 2014, NSF plans to enhance support (+\$13.85 million) for an NSF-wide integrative activity on neuroscience and cognitive science. Support will continue for the EAGERs, RCNs, and INSPIRE, and will include research on understanding the brain, including mapping of circuits that drive behavior in a variety of organisms. A cross-foundation AIR-NCS solicitation will be released that builds on the foundation and themes in the FY 2013 DCL.

Consolidation of federal STEM education programs

Question 6. The Administration's FY 2014 budget request includes a proposal to reduce or consolidate 114 STEM programs across the federal government. The proposal shifts a number of those programs being consolidated to NSF, and NSF is consolidating some of its own programs. How were programs evaluated to determine whether or not they should be consolidated or cut? Does NSF have the capacity to effectively and efficiently run all of the programs that are being brought from other agencies?

Answer: NSF does not interpret the President's proposed STEM-education reorganization to mean that programs from other agencies will be "shifted" to NSF. Rather, NSF programs will be expanded and coordinated within new frameworks and will introduce additional approaches for improved impact and efficiencies. The *functions* of consolidated programs will be reviewed jointly by the lead and collaborating agencies during the implementation planning and transition into this new system of delivering STEM education. As appropriate, critical functions will then be incorporated into existing or new programs at the lead agencies. Under NSF leadership, cross-agency planning has already been underway among the agencies involved in the reorganization of programs in the areas of undergraduate education reform and graduate fellowships.

For the internal undergraduate consolidations at NSF, programs based in the Research and Related Activities (R&RA) directorates that have a full or partial focus on undergraduate education were identified as suitable for inclusion in the broader framework, Catalyzing Advances in Undergraduate STEM Education (CAUSE), to bring coherence to NSF's undergraduate STEM-education reform investment. The programs brought together under the CAUSE framework share common goals such as: improving the quality of undergraduate preparation in STEM; increasing the retention of undergraduates in STEM fields and the quantity of STEM graduates; and addressing issues of institutional capacity and scale. Key findings from past and ongoing evaluations, along with Committee of Visitor recommendations, will be carefully considered as CAUSE planning and implementation proceeds.

The CAUSE program will be managed by NSF's Directorate for Education and Human Resources' Division of Undergraduate Education (DUE). The scientific staff in DUE includes thirty program officers whose expertise span all STEM disciplines as well as research in undergraduate STEM education. DUE expertise will be augmented with program expertise from NSF's R&RA directorates that oversee programs included in the internal consolidation, and through collaborations with staff in undergraduate programs from other agencies. CAUSE will be anchored by the consolidation of three major DUE programs: Transforming Undergraduate STEM Education (TUES), Widening Implementation and Demonstration of Evidence-Based Reforms (WIDER), and the STEM Talent Expansion Program (STEP). Combining these three programs into a single program will enable significant efficiencies in reviewing proposals, project oversight, evaluation, and program design and improvement. NSF is confident it has and can amass sufficient scientific, education, and administrative capacity to lead this initiative within the proposed budget.

Several programs in the proposed STEM education reorganization are graduate fellowship programs at mission agencies. As the lead agency for STEM graduate fellowships under the reorganization, NSF has proposed expanding its Graduate Research Fellowship Program to include a set of "targeted opportunities" that will enable graduate fellows funded by NSF to participate in the mission-specific graduate experiences that would improve their career readiness and address national scientific needs. NSF's Division of Graduate Education is adequately staffed to design and manage the initial stages of this expansion, and will partner with colleagues across government who work together regularly on graduate fellowships.

**Questions for the Record Submitted by
Daniel Lipinski**

Advanced Manufacturing

Question 1. Dr. Marrett, the National Science Foundation (NSF) is proposing an increase in nearly \$50 million in support for advanced manufacturing in fiscal year (FY) 2014. Can you describe NSF's contribution to the Administration's efforts in advanced manufacturing R&D? Specifically, can you describe NSF's role in and level of commitment to the National Network for Manufacturing Innovation?

Answer: NSF's core scientific and engineering programs have produced many fundamental advances that have enabled and continue to enable breakthrough manufacturing technologies, many implemented worldwide. Now, core research programs and special initiatives will achieve similar results by bringing research communities together to address critical manufacturing needs that cross disciplines. The Foundation's Cyber-Enabled Materials, Manufacturing, and Smart Systems (CEMMSS) portfolio will spur marketplace innovation, leading to high technology jobs and industrial growth in the United States. Many efforts will be highly coordinated with our interagency partners to avoid duplication and increase effectiveness of NSF funded efforts.

The Foundation's FY 2014 Request of \$159.73 million includes major emphasis areas such as:

- Research to advance sensor- and model-based smart manufacturing, advanced robotics and materials, and nano-manufacturing;
- Research on Cyber Physical Systems (CPS) will transform static manufacturing systems into adaptive, "smart" systems that can sense and adapt to environmental change;
- Likewise, the multi-agency National Robotics Initiative (NRI) will help develop robots that work beside, interact cooperatively with, or assist people in performing a variety of tasks;
- In response to the Administration's Materials Genome Initiative (MGI) research will continue through NSF's Designing Materials to Revolutionize and Engineer our Future (DMREF) activity. Research focuses on the manufacturing aspects of the synergistic use of experiment, theory, computation, and data driven research approaches to more rapidly discover, process, and deploy useful materials, including bio-inspired materials.
- Manufacturing enterprise systems, manufacturing and construction machines, and materials processing and manufacturing of materials and biomaterials;
- Advanced semiconductor and optical device design, fabrication and processing, for application in biomedical, alternative energy, communications, computing and sensing systems;
- Fundamental research in chemical and materials syntheses and processing, especially at the nanoscale underpins and will accelerate developments in advanced manufacturing of commodity chemicals and functional materials.
- The National Nanotechnology Initiative (NNI) Signature Initiatives: Sustainable Nanomanufacturing and Nanoelectronics for 2020 and Beyond;
- Capabilities for the 21st century, specifically those associated with complex engineering systems design and manufacturing; and
- A variety of activities aimed at bolstering industry/university interactions, such the Industry/University Cooperative Research Centers (I/UCRC) program.

Concerning NSF's contribution to the Administration's efforts in advanced manufacturing R&D, and specifically, the Foundation's role in and level of commitment to the National Network for Manufacturing Innovation (NNMI), NSF has been participating in meetings with the National Economic Council (NEC), Office of Science and Technology Policy (OSTP), and senior leaders from various agencies to strengthen interagency coordination and improve efficiency and effectiveness of the U.S. Government's advanced manufacturing investments through coordinated and collaborative ventures. NSF feels that participation in these efforts significantly increases the impact of our basic research investments in areas cited above while increasing the relevance of our research programs.

NSF's greatest strength is its university-based research community. The pilot institutes planned under NNMI offer the opportunity to more tightly integrate NSF basic research activities and our STEM educational programs with the more focused and applied research and development activities occurring at the institutes. We plan to do this in ways that were recommended in the Advanced Manufacturing Partnership (AMP) report published by PCAST in July, 2012: *Report to the President on Capturing Domestic Competitive Advantage in Advanced Manufacturing*. Toward that end, NSF's role in the 2012 pilot institute and the additional three planned institutes is described below.

NSF supported the first pilot institute on additive manufacturing managed by the Department of Defense (DOD) through a \$1.0 million direct investment with the goal of facilitating collaboration, enhancing opportunities for technology transition, and coordinating educational activities with existing NSF grantees. NSF is an active partner in this multi-agency management team. It is noteworthy that the fundamental research in additive manufacturing was supported by NSF in the early 1990s.

NSF will partner with DOD and the Department of Energy (DOE) to support three additional institutes (2 DoD, 1 DOE) that were described during the President's State of the Union address. NSF plans on investing directly in the two new DOD institutes, and we envision supplements to NSF Grantees' research to establish collaborations with institutes, including supplements to support students/post-docs working with/onsite at the institutes; establishment of linkages between institutes and existing NSF/ATE programs; as well as potentially placing students on site, sharing best practices, curricula development with industry, etc. In addition to these DOD and DOE efforts, NSF anticipates working closely with the Department of Commerce on additional institutes, if the full NNMI is authorized and funded by Congress.

Informal STEM Education

2. Dr. Marrett, NSF is proposing a significant cut to the informal STEM education program (AISL) even as the overall Education and Human Resources budget grows. I understand this may be part of the larger Administration STEM overhaul that creates a new role for Smithsonian in federal informal STEM efforts, but I still have concerns.

Question: How do you justify this cut in an otherwise growing budget? How will you work with the Smithsonian to help build their capacity to support informal STEM education and outreach across the nation? How will you work with science centers across the country as you refocus the AISL program? Also, I worry this cut could diminish NSF's opportunities for branding, which increases public recognition and support for the NSF mission. Can you comment on that aspect of it too?

Answer: NSF's unique role in informal STEM learning/engagement is to support research and development in order to develop an evidence base around exciting, innovative models for informal learning. This is accomplished through collaborations among educators, scientists, and other technical professionals, and is supported through multiple NSF programs, including Advancing Informal STEM Learning (AISL). The FY 2014 funding level proposed for AISL is to ensure its research focus on innovative learning and engagement strategies amidst the increasingly broad set of environments in which STEM learning occurs outside of school. Coordination of NSF programs that fund informal STEM-education [primarily AISL plus Discovery Research K-12 (DR-K12), Research on Education and Learning (REAL), Innovative Technology Experiences for Students and Teachers (ITEST), and Cyberlearning Learning Transforming Education (CTE)] with the public engagement and outreach programs of NSF-funded Research and Related Activities (R&RA) projects will not only achieve resource efficiencies but will provide real-time, ongoing test beds for understanding how STEM learning occurs beyond the school environment.

New "non-traditional" players in informal STEM education, such as the business community, private foundations, civic groups, technology developers, and other out-of-school entities, also create new opportunities to leverage resources through strategic collaborations. New social models, approaches to scientific research, and emerging technologies, such as citizen science, virtual networks, cyber-enabled learning, and educational gaming, create rich but unexplored opportunities to reach broad out-of-school and lifelong learning communities.

AISL investments will continue to advance the field by funding innovative projects that further understanding of how best to increase the STEM knowledge, practice, infrastructure, and professional capacity of people participating in informal STEM-learning settings. Those interventions can then serve as tested models, with strong evidence bases, for wider implementation and use at full scale through partnerships with other entities, such as the Smithsonian Institution, and be taken to scale through networks funded by the Department of Education.

Through the Office of Legislative and Public Affairs, NSF seeks opportunities to highlight all NSF-funded research. Those efforts would not be impacted.

Consolidation of federal Graduate and Undergraduate STEM Education programs

3. Dr. Marrett, as part of the broad overhaul of STEM education programs being proposed by the Administration, NSF has been designated the lead agency for federally supported undergraduate and graduate-level programs, including programs that have been managed within their respective mission agencies for years.

Question

- **At the graduate level, the NSF Graduate Research Fellowship Program is being expanded to be a National Graduate Fellowship Program (NGFP). As mission agencies phase out their own graduate fellowship programs, how will you ensure that the mission-specific needs of those agencies continue to be met under NGFP? What interagency infrastructure is in place or will you have to establish to meet this goal?**
- **Likewise, how will you address consolidation at the undergraduate level in terms of making sure that the mission-specific needs of the agencies and the research communities they support are being met?**

Answer: The President's proposed STEM-education reorganization, which designates NSF as the lead federal agency for STEM undergraduate and graduate education, expands and coordinates NSF programs within new frameworks that introduce additional approaches to achieve improved impact and efficiency. NSF staff will continue to collaborate with colleagues from agencies whose undergraduate programs and graduate fellowship programs are being realigned to fully understand the specific goals and operational features of those programs, as well as the agency assets (e.g. laboratories, facilities, scientists, and instruments) that have been available to participants in those programs. As much as possible, NSF will incorporate into these realigned programs (Catalyzing Advances in Undergraduate STEM Education or CAUSE, National Graduate Research Fellowships, and NSF Research Traineeships) the intentions and goals of programs from other agencies, and will be cognizant of how NSF's programs can meet the particular educational goals of science mission agencies. NSF staff will work collaboratively with other agencies to determine how participants in the NSF programs can have appropriate access to facilities and assets of other agencies as part of their preparation for the STEM workforce.

Although pre-planning had been underway, the White House organized a meeting of agencies after the release of the FY 2014 Budget to move forward in implementation planning of realigned programs, including the National Graduate Research Fellowship Program (NGRF). As described in the FY 2014 Budget, the NGRF design will include opportunities for fellows to obtain the technical and professional development specified by the mission agencies. In addition, NGRF administration will include mechanisms for mission agencies to be involved in selecting fellows in general, and, more specifically, for participation in specialized technical and professional development relevant to their agencies. The Interagency Working Group on STEM Graduate Fellowships and the NSTC Committee on Science, Technology, Engineering, and Mathematics Education (CoSTEM) are two interagency groups that provide infrastructure to help ensure the mission-specific needs of agencies are met. Meetings between NSF and individual agencies are underway to address considerations specific to each agency.

NSF's new CAUSE program is a natural evolution and consolidation of the Foundation's ongoing efforts to couple STEM disciplinary expertise with education-research expertise to better understand and improve undergraduate STEM learning and persistence of students from all groups and to support STEM workforce development. Developing the framework for CAUSE will be informed by input from others who have been managing undergraduate programs in their respective mission agencies. Conversations with those agencies are underway and will continue.

OMB hosted a meeting with representatives from NASA, the National Oceanic and Atmospheric Administration, the National Institutes of Health, and the Department of Defense to initiate conversations about goals, priorities, and ways to leverage each other's assets to support the implementation of the STEM reorganization, including in the area of undergraduate education. NSF staff have initiated subsequent meetings with USDA and the Department of Energy and will soon host a gathering of all federal agencies that have investments in undergraduate education. In addition, we will continue to engage with agencies one on one. Our conversations build upon and are guided by the extensive collaborative work that has been underway for several years through CoSTEM to leverage our collective expertise and assets to improve undergraduate STEM education.

Astronomy Portfolio Review

4. Dr. Marrett, last year the Astronomy Division carried out a community-based review of its full portfolio of facilities. Taking into consideration limited budgets and new telescopes coming online over the next several years, the reviewers recommended that NSF take steps to divest a number of older telescopes. I am hearing concerns from the community that the proposed schedule for divestment decisions by the end of 2013 may be unattainable even as stakeholders work together to develop new sources of funding to keep some of these telescopes operational.

Question: What would be the consequences of granting additional time for potential consortia to develop more fully?

Answer: NSF has stated publicly that decisions regarding divestment paths will need to be taken near the end of Calendar Year 2013 in order to realize savings in the FY 2017 budget. NSF also has stated publicly that this does not require fully formed consortia and signed Memoranda of Understanding by the end of 2013, but does require significant evidence of likely commitment levels beyond e-mail expressions of interest. Deferring divestment decisions will carry the realization of savings out to time frames beyond FY 2017.

Depending on the amount of delay, this most likely will result in one or more of the following:

- (1) reduction of individual investigator funding rates to less than 10 percent, or complete cancellation of individual investigator programs in some years beginning in FY 2015-2016, depending on which budget scenarios are realized for MPS/AST;
- (2) delay of the Mid-Scale Innovations Program that was the number two priority for large ground-based projects in the 2010 decadal survey and is included in the NSF FY 2014 Budget Request to Congress;
- (3) inability to commit to operations of the Advanced Technology Solar Telescope (ATST) beginning in FY 2015;
- (4) deferral of the construction start of the Large Synoptic Survey Telescope, also in the FY 2014 Budget Request, because of a lack of projected funding available for operations, which begin in 2018-2019.

Question: Can you tell us where things stand with respect to considering and implementing the Portfolio Review recommendations, including any schedule for management decisions on these facilities?

Answer: NSF has separated two telescopes, the Green Bank Telescope and the Very Long Baseline Array, from the primary management competition for the National Radio Astronomy Observatory (NRAO), in order to provide maximum flexibility for the development of funding partnerships. NSF is preparing solicitations for competition of the management of the National Optical Astronomy Observatory (NOAO) and of NRAO that describe the scope of those observatories beyond 2015. NSF has asked its observatory management organizations to solicit expressions of interest from potential partners, which in some cases have led to direct discussions between NSF and the possible partners or consortia. Some of these potential partners are university-based, and some are other federal agencies. NSF continues to hold to its schedule of making divestment decisions by the end of 2013.

Question: Finally, how will you seek community input on the implementation of the Portfolio Review?

Answer: The Portfolio Review was an inherently community-based process, with a broadly representative committee of community astronomers that solicited input from individual astronomers and from representatives of all the national astronomy facilities. Furthermore, the Portfolio Review instructions required them to accept the science and program priorities set by the National Academy decadal surveys, which were based on extensive community input and discussion. The results of the Portfolio Review, and the NSF plans as they develop, have been presented in multiple town hall meetings of the American Astronomical Society, to multiple standing National Academy advisory committees, to the Astronomy and Astrophysics Advisory Committee (AAAC, chartered by Congress), to a meeting of the country's astronomy department chairs, and via a web-based presentation to the entire community; in all these forums, ample opportunity was given to ask questions. Discussions regarding implementation have been held with the managing organizations of the national facilities as well as with representatives of tenant organizations that operate on NSF observatory sites.

Responses by The Honorable Dan Arvizu

**QUESTIONS FOR THE RECORD
THE HONORABLE LARRY BUCSHON (R-ID)
U.S. House Committee on Science, Space, and Technology
Subcommittee on Research**

An Overview of the National Science Foundation Budget for Fiscal Year 2014

Wednesday, April 17, 2013

1. What are examples of NSF-related policy issues that you and the board currently disagree? Please elaborate.

There are no outstanding policy disagreements between the Chairman and the National Science Board (Board or NSB). The NSB consists of 24 highly accomplished, independent members plus the NSF Director, all of whom are dedicated to providing their best possible guidance regarding NSF policies, programs, and strategies. They represent the breadth of the scientific enterprise: academia, industry, the non-profit sector, and a wide range of science and engineering disciplines. As was intended when this large, expert group was designed to oversee NSF, we do not all have the same perspective on all matters, so we do not all agree at all times. When voting, we are often not unanimous. However, it is my responsibility as Board Chairman to ensure that divergent opinions are aired for the good of the Foundation and that all important information and perspective are offered and constructively received and handled by the Agency. After all discussion, the Board acts as a single entity and, as Chairman, I represent that view.

There are occasional policy disagreements between the Board and the NSF Director, as noted in the response to Question 2 below.

2. I want to be assured that the Board is simply not 'rubber-stamping' the Director's priorities and agenda. The point of the NSF Board is to provide independent and honest advice to the NSF Director. In your opinion, has this been happening? Could you please comment?

Per the Foundation's organic act (42 U.S.C., §§ 1861-87), the National Science Foundation consists of the National Science Board and the Director. Together we are responsible for the functions of NSF. The Board is allowed to delegate certain responsibilities to the Director, though we may not abdicate our responsibilities to oversee the development of policy, rules and regulations; to authorize certain expenditures; and to issue certain publications. The Board maintains its independence from NSF by means of its independent budget and staff, including independent legal counsel. Further, the Office of the Inspector General that oversees the NSF reports directly to the Board, which ensures the independence of that Inspector General's office.

The Board members take our statutory responsibilities seriously. We maintain both careful oversight and constructive involvement with the Foundation in order to be as effective in our stewardship as possible. We can assure you that NSB is not a "rubber stamp" for NSF

decisions. As an engaged oversight body, NSB is far more involved and valuable to the Foundation than a rubber stamp could be.

To offer a highly visible example of a disagreement between NSB and NSF: in December 2010, the Board declined to authorize funds for a Deep Underground Science and Engineering Laboratory (DUSEL) that NSF requested. This was a late-stage denial and we recognized that our decision would be unwelcome.

Less visible from outside the Foundation is the fact that it is common for NSB to revise NSF's draft resolutions during deliberations. In addition, we often add strictures for tighter internal controls and reporting requirements before approving awards. For example, starting in 2007, the Board began stressing the importance of recompeting management for our large scientific facilities and infrastructure investments. We have, since that time, regularly added deadlines for recompetition and demanded realistic plans for ensuring recompetition to our resolutions before authorizing large investments or renewals.

The Board strives to guide NSF policies and decisions proactively, so that good guidance is in hand and good decisions are made well before final approval points. Done well, this leads to few dramatic rejections and better Agency management. For example, during the past year NSB asked NSF to bring several topics known to be of scientific interest but not at this time institutionalized as programs to NSB for discussion: Neuroscience, Water, and Big Data. Preparation for these discussions takes significant staff time and effort, and we perceive that there has been some resistance from NSF as a result, but the Board considers it vital to hold these conversations so that the Agency will scrutinize these issues early and so the Board can assess the Agency's awareness, processes and capabilities related to these important topics.

I was gratified to hear Dr. Marrett specifically mention, during questioning by your subcommittee on April 17, 2013, that the Board-NSF Neuroscience discussions had been helpful to NSF. As a result of this engagement with the Board on cross-cutting neuroscience research, NSF was better prepared when the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) initiative was recently announced.

3. The pressure by investigators to obtain research grants will increase, especially in this competitive research funding climate. I believe most investigators will apply for NSF grants with integrity and also conduct their research in a noble manner. However, the number of cases of research misconduct is growing. Do you believe that this situation will get worse with time? If yes, what is behind this growth? Please explain.

Concern over potential misconduct led Congress, through America COMPETES, to require NSF to ensure that each institution that applies for funding to certify that they have a plan in place to provide training in responsible and ethical conduct of research for their undergraduates, graduate students and postdoctoral researchers. In addition, NSF has gone beyond the legislative requirements to implement policies that will lessen misconduct in the future. For example, NSF has altered its award conditions so that no award can be made unless the institution verifies that its students/postdocs receive such training. NSF has also

funded and is overseeing the development of a National Professional and Research Ethics Portal to provide free resources for scientific integrity training to any interested researcher, teacher or institution. NSF also conducts outreach to institutions to help develop and improve research integrity activities and has offered several funding opportunities in this sphere. We are hopeful that these activities will minimize research misconduct in NSF submissions and beyond.

The Board shares your concern about scientific misconduct and recognizes that intense competition may create incentives for increased dishonesty. While we hope that the initiatives described above will prevent this problem from getting worse, the Board is keenly interested in this issue. We strongly feel that declining integrity would jeopardize the research enterprise. Our Office of the Inspector General is beginning to use data analytic tools that can identify misconduct. The Board's philosophy is that such tools should be deployed in ways that maximize deterrence, coupled with effective training and assistance in compliance.

4. I am concerned that the emphasis on clean energy research may be at the expense of other potentially transformative research. How can we ensure that this will not become the case?

NSF is unique among Federal agencies in that it funds basic research across all fields of science, technology, engineering, and mathematics (STEM). These investments help create a robust and diverse knowledge base that serves as the "seed corn" for future innovations. Through its rigorous merit review process, NSF ensures that the research it funds is of the highest scientific quality and has the potential to address societal goals. One such goal is improving the basic understanding of the fundamental principles and processes at the heart of energy research. NSF's basic research investments in this area may lead to transformative breakthroughs for clean energy and for other purposes. History has demonstrated that the knowledge generated by basic research is frequently generalizable to many fields, often in unpredictable ways.

NSF's strategic focus on clean energy is well integrated within the core, basic research programs across the Foundation. Given the constrained budget environment the National Science Board and NSF remain especially vigilant in ensuring that the Foundation's overall research portfolio continues to be balanced and focused on its basic research mission. Many Board members remain active researchers, and they are especially cognizant of the need to balance special initiatives with core research programs.

5. What is the opinion of the National Science Board on the proposed large scale consolidation of STEM programs across the federal government? Was the National Science Board consulted in any of the decisions regarding reducing or consolidating the NSF STEM programs?

NSB is supportive of the overarching goals of this proposed consolidation, namely improving the efficiency and effectiveness of Federal STEM education investments. We are also supportive of the intent to enable better deployment of evidence-based approaches to improving STEM education. Although the Board has not taken an explicit position on the

proposed cross-agency reorganization, we are fully confident in the Foundation's ability to successfully integrate the reassigned elements into its portfolio.

The Board was briefed on the 2011 Co-STEM "education portfolio" report that preceded the consolidation plan and in February 2013 we were informed of the general types of responsibilities that would fall to NSF under the consolidation. The Board has not been directly engaged in the plans for the consolidation, which is appropriate given that this is a consolidation across agencies and that the Board has oversight responsibilities for only NSF. The Board expects to be consulted on the implementation plan as it is developed after the release of the final Co-STEM report, and we are looking forward to working with the Director, OSTP, Congress, and the other agencies involved to improve STEM education.

Appendix II

ADDITIONAL MATERIAL FOR THE RECORD

NATIONAL SCIENCE FOUNDATION BUDGET HEARING INSERTS

Testimony Insert #1 Page 26a
Committee on Science, Space, and Technology
Subcommittee on Research
April 17, 2013

An Overview of the National Science Foundation Budget for Fiscal Year 2014

NSF is committed to make targeted investments in collaborative science and innovative technologies to accelerate discovery that will revolutionize our understanding of the brain. NSF is uniquely positioned to foster brain research by bringing together a wide range of scientific and engineering disciplines working together to reveal the principles underlying memories, thoughts, and complex behaviors.

Despite major technological advances during recent decades, a comprehensive understanding of how thoughts, memories, and actions actually emerge from dynamic activities in the brain remains elusive. The BRAIN Initiative extends beyond the mere mapping of the brain and bridges scales that span synapses to behavior, linking what is known about single neurons to whole brain function. This initiative holds great promise for addressing fundamental neurobiological questions about healthy brain function, advancing treatments for brain disorders or traumatic brain injury, and for generating brain-inspired “smart” technologies to meet our future needs as a society.

NSF has taken a strategic approach in developing an overarching framework for the BRAIN Initiative that includes community input and a staged implementation plan, in consultation with NIH and DARPA. Among the first activities of this effort was a recent NSF-sponsored workshop entitled, “Physical and Mathematical Principles of Brain Structure and Function.” This well-attended workshop included Nobel laureates, physicists, mathematicians, and neurobiologists from around the world, consisting of an open-format designed to foster cross-disciplinary dialogue that articulated important goals for NSF’s role in the BRAIN Initiative.

Key goals included:

- Identification of neural signatures that can predict complex behavior.
- Development of models that define the computational aspects of functional neural networks.
- Establishment of a theory of brain function.
- Strategies for unprecedented levels of global data sharing for brain research and education.

NSF’s contributions to the BRAIN Initiative will transform the way science and engineering disciplines collaborate to revolutionize our understanding of the human mind.

Workshop link: <http://physicsoflivingsystems.org/brainstructureandfunction/>

Testimony Insert #2 Page 30a
Committee on Science, Space, and Technology
Subcommittee on Research
April 17, 2013

An Overview of the National Science Foundation Budget for Fiscal Year 2014

The FY 2014 Budget Request for the Social Behavioral and Economic Sciences Directorate is \$272.35 million, which represents 3.6 percent of the National Science Foundation's FY 2014 Budget Request of \$7,625.78 million.

Testimony Insert #3 Page 35a
Committee on Science, Space, and Technology
Subcommittee on Research
April 17, 2013
An Overview of the National Science Foundation Budget for Fiscal Year 2014

See NSF's response to Chairman Bucshon on Testimony Insert #1, Page 26a.

Testimony Insert #4 Page 46a
Committee on Science, Space, and Technology
Subcommittee on Research
April 17, 2013

An Overview of the National Science Foundation Budget for Fiscal Year 2014

In the FY 2014 Budget, NSF requests \$372.45 million for Clean Energy Initiatives and \$326.38 million for the U.S. Global Change Research Program (USGCRP). These amounts are separate and there is no overlap.

In order to leverage the rapid change in computing and related technologies, coupled with the exponential growth and complexity of data, NSF has created a new vision and strategy towards advanced computing infrastructure, which will expand NSF's leadership role in the science, engineering, and education enterprise. This is outlined in the *Cyberinfrastructure for 21st Century Science and Engineering Advanced Computing Infrastructure Vision and Strategic Plan*: <http://www.nsf.gov/pubs/2012/nsf12051/nsf12051.pdf>.

NSF has been a leader in Networking and Information Technology Research & Development (NITRD) funding for high end computing for four decades. The FY 2014 budget funds the following high end computing program activities:

High-End Computing Infrastructure and Applications (HEC I&A) (\$248.44 million) HEC I&A includes increased efforts by the Directorate for Computer and Information Science and Engineering's (CISE) Division of Advanced Cyberinfrastructure (ACI) to develop software and algorithms and to support operations and maintenance costs for high-end computing systems—Blue Waters Petascale Computing; the innovative high performance computing program (Keeneland, Blacklight, FutureGrid, Gordon, Kraken, Lonestar, Ranger, Trestles and Stampede); and the eXtreme Digital (XD) services program that focuses on advanced distributed open cyberinfrastructure comprised of shared user and management services. It also includes the Directorate for Mathematical and Physical Sciences (MPS) and the Directorate for Engineering (ENG) investments in new computational methods, algorithms, robust software, and other computational tools to support researchers in the mathematical and physical sciences and engineering. The CISE investment in computational infrastructure as part of Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21) is reflected here, as well as the development of wireless testbeds that support experimentation with new wireless technology services as part of Enhancing Access to the Radio Spectrum (EARS). The Directorate for Geosciences (GEO) supports EarthCube, a CIF21 investment that sustains cyberinfrastructure for the geosciences. HEC I&A also includes investments in innovative partnerships and collaborations between universities and industries, including the Industry/University Cooperative Research Centers program; GEO's support for the Climate Simulation Lab activity at the National Center for Atmospheric Research (NCAR) facility; and the Directorate for Biological Sciences' (BIO) support for development of pioneering informatics tools and resources that have the potential to transform research in biology.

High-End Computing R&D (HEC R&D) (\$113.57 million) Support is provided for CISE nanotechnology research, including participation in the National Nanotechnology Initiative. HEC R&D also includes support for NSF's investment in Science, Engineering, and Education for Sustainability, focusing on research that will develop the theory and design principles to effectively tackle energy versus computation and communication tradeoffs and the development of new theory, algorithms, and design principles to optimize energy-computational performance in computing and communications systems. HEC R&D also includes support for CIF21 to develop new functional capabilities in support of highly parallel computing and BIGDATA analytics, as well as research on technical and economic models for flexible spectrum access, real-time auctions, and on-demand spectrum services as part of EARS. MPS, through the Division of Materials Research, will support research on quantum effects and their use for information science, potentially leading to new paradigms for high-end computing.