This testimony is submitted for the record on behalf of the University of California, Berkeley, a non-profit public institution of higher education located in Berkeley, CA.

As the Vice Chancellor for Research and on behalf of the University of California, Berkeley, I urge the Committee to support the President’s proposed increases for the federal science agencies in the fiscal year (FY) 2012 budget, including $7.767 billion for the National Science Foundation (NSF). Increases to NSF as authorized in the America COMPETES Reauthorization Act of 2010 will help universities make grand discoveries, conduct critical research, help solve national challenges, and power our innovation economy.

In particular, I want to address the importance of NSF’s contribution and future role in the development of a deep underground scientific facility in South Dakota.

For the past four years, the University of California, Berkeley has led a nationwide team of scientists and engineers designing a Deep Underground Science and Engineering Laboratory (DUSEL), in partnership with NSF and the Department of Energy (DOE), at Homestake mine in Lead, South Dakota. In total this collaboration numbers in excess of 1,000 scientists and engineers from universities and labs in 33 states as well as international partners from Europe, Asia and Canada. Consistent with the principles of the NSF, DUSEL would be a national resource to be open, on a peer-reviewed, competitive basis, to projects sponsored by U.S. federal agencies and to cooperative international activities.

The Homestake mine in Lead, South Dakota operated for 125 years as a gold mine, but it was also a home to pioneering physics research. Dr. Raymond Davis, Jr. conducted a pivotal neutrino-detection experiment at Homestake during the late 1960’s and through to 1995 for which he received the Nobel Prize in Physics in 2002. Dr. Davis built his lab deep underground at Homestake to shield his experiment from cosmic radiation.

The envisioned program in physics and astrophysics will address fundamental questions about the Universe and its fundamental laws, such as the question of why the universe contains matter but no antimatter, the nature of dark matter, the origin of neutrino mass, and the genesis of the chemical elements. The biology program will study life in extreme conditions underground to shed light on the origin and evolution of life. The geosciences program will have opportunities to study directly at depth a variety of the thermal, hydrologic, mechanical, chemical, biological-mass, and energy-transport phenomena on a scale not done before. The engineering program will study rock properties in situ to enable better design and use of underground space.

The flagship scientific program for DUSEL is in the area of fundamental subatomic physics, with four ambitious experimental programs:
1. Experimental detection of dark matter particles
2. Neutrinoless Double Beta Decay
3. Nuclear astrophysics
4. Long-Baseline Neutrino Experiment (LBNE) and Proton Decay

In each of these areas of science, the DUSEL experiment would represent a unique contribution to a world-wide campaign. With this scientific program, the Deep Underground Science and Engineering Laboratory will be at the forefront of fundamental subatomic physics worldwide for decades.

Scientific questions to be addressed in an underground facility such as DUSEL are intricately connected to the fundamental purpose of NSF to support cutting-edge basic research through directorates such as Biology (BIO), Geosciences (GEO), Engineering (ENG), and the Math and Physical Sciences (MPS).

The knowledge ultimately generated by underground science at DUSEL would also provide benefits for the nation’s environment, safety, and national security. For example, studies conducted at DUSEL could potentially help scientists improve methods for waste isolation and carbon dioxide sequestration, better understand earthquakes, and develop radiation detection methods used for national security purposes.

The former Homestake mine consists of 370 miles of existing tunnels and dozens of shafts, raises, ramps and caverns much of which would be available for deep underground science. The laboratory under development at Homestake has the capacity to house experiments at levels as deep as 8,000 feet beneath the surface, making it the largest and deepest underground laboratory in the world. In fact, it would more than double the world's total inventory of underground lab space.

A robust team of leading minds from around the country is currently completing the DUSEL Preliminary Design report which will help inform future federal plans with this facility. Moreover, this spring and summer DOE and the National Research Council respectively are completing reviews of options and further evaluating the scientific capabilities of such a facility – in which I believe future Nobel prizes will be won – vis-à-vis other opportunities in science.

NSF should leverage the ongoing DOE investment in FY 2012 and beyond and ensure that the broadest array of scientific questions is addressed with this truly one of a kind opportunity.

Why should the National Science Foundation continue to support the development of the project?

Major advances in science and engineering often require facilities in extreme environments to investigate processes under conditions that are not available in normal laboratories. Over the last decade, a series of reports outlined compelling questions in modern science that can be answered only in a deep underground environment. In response to this, the science community has overwhelmingly supported the construction and operation of a national underground laboratory. Recent reports from organizations such as the DOE/NSF High Energy Physics Advisory Panel’s (HEPAP’s) Particle Physics Project Prioritization Panel and the National Research Council have
identified the benefits of deep underground laboratories and highlighted compelling scientific questions that can only be answered by experiments conducted in this extreme setting.

Research communities in physics, geosciences, engineering, biology, and other fields have further refined the questions and defined the critical experiments that would require access to scientific facilities deep underground. Recognizing the importance of this facility and the overwhelming support of the scientific community, the National Science Foundation, which supports research across science and engineering fields, established a formal process through which the detailed scientific goals for an underground laboratory could be defined and the characteristics and benefits of various potential sites and experiments could be evaluated. NSF has also sponsored workshops and funded 15 awards across the research spectrum to study initial experiments for early science which could be conducted in such a unique underground laboratory environment.

The implications of the future research at DUSEL go far beyond the science discoveries themselves, as opportunities to attract students at all ages have been built into the plan, with the potential to redirect future scientists to the U.S. rather than our foreign competitors. A major benefit to a deep underground facility in South Dakota will be the education and outreach programs about the ground-breaking science which will inspire young investigators and promote the development of the next generation of U.S. scientists and engineers. As many as 10,000 scientists will benefit from DUSEL each year through education and outreach opportunities.

At its core, the vision developed by the nationwide team addressing this deep underground laboratory is focused on creating innovative and revolutionary methods of teaching science that will have national applications. DUSEL will help train the next generation of young scientists and engineers, consistent with the goals of NSF to enhance training in science, technology, engineering, and math disciplines as well as the overall commitment to education and public outreach. The anchor of the education and outreach effort will be the Sanford Center for Science Education in Lead. The facility will accommodate school children, K-12 teacher development groups, and casual visitors and also will include a distance education component, research experience, and other programs. Further, DUSEL’s location in an economically disadvantaged region with an American Indian population of 8-10 percent gives the Sanford Center for Science Education a unique opportunity to affect change in this area.

Most importantly, the impact this facility will have can be seen from the impact it is already having in the State of South Dakota and the region. Summer scholarships, intern programs for students in science to conduct research at DOE’s Fermi National Accelerator Laboratory in Batavia, Illinois, and a new Master’s degree and doctoral degree program in physics within the South Dakota university system have all been developed as a result of the future DUSEL facility. This national leading facility will bring world leading experts from around the globe to a state which participates in NSF’s Experimental Program to Stimulate Competitive Research (EPSCoR) – the goals of which are to provide strategic programs and opportunities for participants that stimulate sustainable improvements in their R&D capacity and competitiveness and to advance science and engineering capabilities in EPSCoR jurisdictions for discovery, innovation and overall knowledge-based prosperity.
Should the U.S. be making an investment in a national underground facility at a time of significant budgetary pressures?

As this Committee is well aware, investments in science and engineering are precisely the types of investment which ought to be protected to ensure our nation’s ability to compete in future global economic markets. More than half of our economic growth in the United States since World War II can be traced to science-driven technological innovation and the seed corn for this innovation has been scientific research conducted at universities and supported by the federal government through agencies such as the National Science Foundation.

As the former Deputy Director of the Lawrence Berkeley National Laboratory and someone who has been involved with the U.S. energy and intensity physics programs for decades as well as supporting Berkeley’s underground research efforts in far flung sites in Japan, Canada and Italy, I know these scientific frontiers hold the promise for revolutionary discoveries that could fundamentally change the way the U.S. can understand, interact with, and harness elements of our universe. During this time in which the energy frontier and some of our brightest minds have been shifting to Europe for the development, operation, and promise of science from the Large Hadron Collider, the U.S. must not cede our leadership in another discovery frontier. A robust national program in elementary particle physics is a central component of both the NSF and DOE contributions to fundamental physics research and it is required for the U.S. to remain competitive on the international scale.

As a top scientific priority for NSF as well as the Department of Energy, DUSEL was being planned into out-year budgets for both agencies as recently as this fiscal year. An investment in the development of a deep underground facility and the research to be conducted therein will have precisely the kind of catalytic impact for our nation that we need to ensure our future competitive standing. It’s this country’s conventional, ongoing, and future commitment to the investment in science and basic research that has and will continue to drive innovation and the creation of jobs around the nation.

In addition, it is more important than ever for the U.S. and NSF to be leveraging financial commitments made by other partners and demonstrating a sustainable development process to keep facilities costs down. With more than $250 million invested to date from federal, state, and private sources, and hundreds of jobs already created, DUSEL is the type of leveraged investment which Congress should be encouraging the U.S. to make in these fiscally constrained times. Beyond the large commitment by South Dakota, there are ongoing contributions from California to study early science issues for developing experiments underground and even educational exchanges in place. For instance, a South Dakota School of Mines and Technology student is currently at the University of California, Davis testing sensors for the Long Baseline Neutrino Experiment being developed the DOE, and NSF is funding 15 teams of investigators for early science. DUSEL is truly driving national collaboration and investment, and it is increasingly becoming international by attracting more and more interest from other countries as the facility design takes shape.

NSF needs to be able to successfully construct the large interagency facilities needed for national leadership in science in a timely, efficient, and cost effective manner. If complications arise due to abrupt changes in NSF planning despite decades of effort or due to disconnects between
components that oversee or control aspects of the project, preventable increases in long term expenses and unnecessary midyear adjustments occur.

Given the size and commitment increasingly required for cutting-edge science to be successful and the complexity of the federal planning, review, and approval processes, the U.S. must be able to demonstrate its ability to construct large scale science facilities which will define the future of specific fields. Moreover, our nation’s ability to deliver on these facilities portends important implications for multi-lateral international scientific collaborations on projects such as DUSEL and future projects around the globe.

Increasingly, the construction of these large facilities not only requires non-federal contributions but multi-agency collaboration within the federal government. In particular, in the America COMPETES Act enacted in 2010 Congress recognized the need for NSF to, “in its planning for construction and stewardship of large facilities, coordinate and collaborate with other Federal agencies, including the Department of Energy’s Office of Science, to ensure that joint investments may be made when practicable.” Building on joint efforts and commitments to date by both NSF and DOE, it is more important than ever that NSF join DOE in its role to steward DUSEL.

In December, the National Science Board made a disappointing and unforeseen decision to not provide any additional funding for DUSEL beyond the Preliminary Design Review, and despite support from the National Science Foundation and commitments made to the project. As DUSEL continues its planning and development, it is my impression that 2010 illustrated the strongest level of collaboration and coordination yet among the Administration, DOE, NSF, and the project team. The level of interagency collaboration that had become central to this project was unprecedented. Further collaboration between DOE and NSF on DUSEL will be a valuable example for future scientific programs and projects.

Because of the intricate scope and complex design structure involved with carrying out a large facility designed to house a wide range of scientific projects, it is important to ensure that this steady forward movement continues. If complications arise, for example, due to future disconnects between various components that oversee or control aspects of the project, results could include preventable increases in long term expenses and unnecessary midyear adjustments as well as significant setbacks to the scope of the scientific discoveries and to the future of large interagency collaborations.

In conclusion, the University of California, Berkeley is committed to working successfully with all agency partners to develop this cutting-edge scientific laboratory, but it is essential that the NSF coordinate with and contribute to the Department of Energy’s efforts in order to create a facility that will provide unique capabilities at the frontiers of science and engineering, in support of the missions of both agencies.