Good evening everyone. I am honored to join this talented, committed, and eclectic group of national leaders, people who get things done … excellently, people knighted with a presidential badge of honor, people who warrant the highest respect from our polity, people we know as Teachers, people without whom the world stops. I was a child of meager means made whole by my Teachers. My life, my career, was enabled by them. In addition to their knowledge, they shared their dreams and hopes for society and guided me for many years. I was part of their grand family and enjoy memories that sustain me still. As just one warm constant memory of their investment in me, guests to our home for dinner are treated to goblets and place settings once prominent in my elementary school teachers’ homes. My Teachers not only taught me - they loved me.

The preparation of all children in math and science not only fuels our science and engineering enterprise -- but, in turn, our economy and way of life. Every citizen needs to understand science and mathematics to participate fully in the life of the nation -- to contribute to its prosperity and to enjoy its benefits.

Your leadership is enormously important for the task that now faces our nation and I am sure you’re up to it. Through thick and thin, from Washington to Obama, we have enjoyed a political structure that is capable of enabling creative transformation by ‘we the people.’

Our predecessors were capable of world-class leadership and we are charged with carrying out that legacy. We are now pointed to transforming our economy. We say, “We can do this.” But just what is the “this” in “we can do this”?

To answer, let’s muse for a bit: sixty-three years ago, on Valentine’s Day, ENIAC was birthed as a behemoth of the earliest days of the computer age. Its weight, 30 tons, equaled that of the gargantuan marble statue of Benjamin Franklin in his National Memorial Hall. ENIAC, the world’s first all-electronic, large-scale, general-purpose, digital computer, stands as a monument to remind us of how far we have come in the past half century - from 30 tons to having the whole world in our hands and under our thumbs. Can we do no less in the next fifty? Well, certainly not without Teachers in the vanguard.
of our effort. You are among the “yes we will” within the mantra of “yes we can” and you are the great enablers within today’s mantra of “innovation.”

Benjamin Franklin, whose 300th birthday just passed in 2006, has been a consummate role model for change with his many scientific and societal innovations and wise guidance. Among the enumerable Franklin quips lies one well suited to our purpose here today, to wit: “Genius without education is like silver in the mine.”

Little did Franklin realize back then that his penchant for education, discovery, and innovation would be so much more enabled today by the onset of computerized data mining. I am sure that he would encourage our nation to be at the head of the line in mining today’s intellectual “silver.”

Franklin also emoted in his autobiography that, “It is in the regions of ignorance that tyranny reigns. It [tyranny] flies before the light of science. Let the citizens of America, then, encourage institutions calculated to diffuse knowledge amongst the peoples …”

History has shown that the United States has acquitted itself well over time in unearthing some of its peoples’ genius through education but, in contrast to this effective mining, we still are not faring as well in distributing the benefits of knowledge in contemporary life.

Coupling these two Franklin admonitions, our new national leaders are at the helm now to make sure the “silver” is mined well and that the “diffusion of knowledge amongst the peoples” is ensured.

Certainly, today’s world impels us to do so. Did you know that the RCA logo is now owned by a Chinese manufacturing company? Gee whiz, to think that I started my engineering career as a proud RCA engineer in Camden, New Jersey, and Nipper, the RCA mascot dog, now speaks Chinese.

Well, as the old saying goes, the world turns and tomorrow’s a new day. No question - round, flat or spiky - our world is ‘turning on its axis,’ carrying each nation right along with it.

What’s happening in the world today is, well, happening. Since the dawn of civilization, forward thinkers have been vital forces in propelling a community’s economy. Vannevar Bush, an engineer and visionary responsible for the genesis of NSF, and who helped set the stage for the striking technological expansion of the past half century, described economic enterprise as "... the free play of initiative of a vigorous people under democracy... [supported by] the advance of science and its application."

Viewing the current scene in this context, we see contemporary thinkers expressing their views in a variety of ways:
In 2005, the National Academies, prompted by Congress, released the report, *Rising Above the Gathering Storm*, a phrase that has motivated the setting of our national compass.

That same year the Council on Competitiveness, a private sector group, published *Innovate America*, which sets forth a set of recommendations to move us ahead in an increasingly competitive global environment.

Other relevant reports in 2005 include a release from the Business Higher Education Forum titled, *A Commitment to America's Future: Responding to the Crisis in Mathematics and Science Education*, and the Business Roundtable publication, *Tapping America's Potential: The Education for Innovation Initiative*.

In 2006, the National Science Foundation’s National Science Board report, entitled *America's Pressing Challenge: Building a Stronger Foundation*, was released.

In 2007, the *American Competes Act* bill, “America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science” was passed.

Also in 2007, the National Governors Association published *Innovation America!* and subsequently awarded several grants for STEM education investment, with all Governors joining as a team to pursue STEM best practices for education and regional growth.

And now we have the *American Recovery and Reinvestment Bill of 2009* positioning itself for passage, portions of which reflect these issues.

And so on …

The power of these documents is that they are all on the same wavelength, are produced by credible minds, everyone is discussing them, the private sector is lobbying for implementation of their recommendations, and both the White House and Congress are using them for policy decisions, with nascent federal bills in play. I believe that they convey to you what you already know: that the dynamic integration of talent, investment, and infrastructure is what makes a modern economy robust.

Taken together, these documents express well what's going on in the world market of ideas, the economy, education, and the workforce. In one way or another they all focus on *innovation*, that is, in the words of the late Peter Drucker, the *process of creating new knowledge and applying it to things that are new and different*. In economic terms, these new and different things brought to market by people in enterprises create fresh wealth, new jobs, and thus prosperity. As a corollary to Drucker’s definition he emphasizes that *knowledge is inherently human* and thus we conclude that educated people are needed at both the front and closure ends of an innovation process.

So, what may come out of all of this? Well, maybe these documents well define innovation as the axis around which the world is turning; taken together maybe they
integrate the separate notions that have compelled some minds recently to describe the world as either round, flat, or spiky.

For example, you know that in 2004, Tom Friedman published a book, *The World is Flat*, that has garnered much attention worldwide. In fact, the flat world metaphor has become a mantra in our daily lives.


In Friedman's book he points out that while Columbus argued that the world was not flat but round, it’s gotten flat again. Starting from the pre-1492 flat, Friedman walks the reader to the present, ultimately pointing out that, in addition to other reasons, the seamless integration of disparate networks into an Internet was "a huge flattener, because it enables so many more people to get connected with so many other people," or paraphrasing the words of Doug Engelbart, inventor of the computer mouse, we now have the capability to access the entire wisdom of the world.

Yet, Stiglitz and Florida metaphorically argue that the world is spiky. Stiglitz posits that the world is not flat, because “economic globalization has outpaced political globalization” causing a growing gap between the rich and the poor. Florida evokes the same theme writing, "In terms of both sheer economic horsepower and cutting-edge innovation, surprisingly few regions [of the world] truly matter in today's economy. What's more, the tallest [economic] peaks - the cities and regions that drive the world economy - are growing ever higher, while most of the valleys languish."

And Samuelson, in spite of the “increasingly powerful effects of globalization,” sustains the round-world metaphor as the older truth of the nation state, namely, that “the nation usually remains, for better or worse, the decisive force in determining the economic conditions of its citizens.”

Whatever, extraordinary transformations have swept through our society and our lives during the past two decades. Changes that we scarcely could have imagined 20 years ago are now our common currency. Today, new technologies – and whole industries – emerge in what seems like the blink of an eye.

We must recognize that civilization is on the brink of a new industrial world order. Economic success will not be garnered by those who simply make commodities faster and cheaper than the competition. Success will be achieved by those who develop talent, techniques and tools so advanced so as to lift us to a dimension beyond competition!
Standing at the nexus of these changes is Franklin’s idea of mining the latent ‘silver’ in our citizen’s minds through education and ensuring that the knowledge so garnered is diffused amongst the peoples.

The essence of knowledge diffusion “amongst the peoples” is the capability to make connections for learning. From drawings on cave walls, to inscribing stone steles, to making connections to learn in Socrates’ small grove (given to him by fellow citizen Academus), through the printing press (used well of course by Franklin to connect with the populous), to the telegraph, telephone, radio (wireless), copper and optical cables, satellites, civilization increasingly lifted its capability for diffusing knowledge amongst the peoples.

Fast-forward to the 21st century, where connectivity is robust, explosive change has become the norm, and knowledge more than ever fuels the engine of innovation. This makes it imperative that we mine the silver in our citizen’s minds by educating the workforce, creating knowledge and ideas, and building the tools to enable both.

Alfred North Whitehead, an eminent mathematician, once said, “The art of progress is to preserve order amid change, and to preserve change amid order.” Eric Hoffer, a longshoreman, social philosopher, and writer advised us that, “In times of change, ‘learners’ will inherit the Earth, while the ‘learned’ find themselves well equipped to deal with a world that no longer exists.”

Educational institutions are charged by society to concurrently preserve core values and to change what is needed to meet the times and move forward. Their leaders must recognize the wisdom of being on-going ‘learners’ as well as being the ‘learned’.

Let’s take a look at the word “engine” in the phrase “engine of innovation.” Our earliest dictionaries taught us that an engine is a device that converts energy to mechanical force and motion. The essence of that definition is creative transformation – energy to momentum.

That process – energy to momentum – speaks directly to the excitement and inspiration of integrative 21st century science and engineering innovation at the frontier. Propelled by advances in genomics, materials, computer-communications, and advances in cognition, mathematics and social science, we are on the verge of new, exhilarating frontiers.

At those frontiers we look for the integration of vast computing power, massive data sets, and simulation science that will enable us to model, understand, and manage the most complex of systems – physical, biological, chemical, environmental, societal and virtual. Moreover, with emerging nanomanufacturing techniques, new materials and systems may be designed and constructed in dramatically new ways.

And an integrated cyberinfrastructure is being born that will enrich and continue to revolutionize discovery, learning and innovation in all intellectual domains. This
distributed infrastructure will integrate a range of heterogeneous tools into a common, persistent and widely accessible national infrastructure, which would include advanced computing engines, federated data archives and digital libraries, cyber-physical systems, and other instrumentation … accessible to all.

And so on ... there is a lot of momentum here. These new capabilities promise to shape and benefit the way we live, work, and progress. The world is ‘turning on its axis.’

Putting ideas to work is a critical element for innovation if a nation aspires to continued success. The present competition from China and elsewhere is just the beginning of a global economic pattern that will become ubiquitous. To prosper on this playing field, leadership demands our being a paradigm ahead, that is, to continually reach the next dimension of capacity to be competitive.

Innovation moves us forward earnestly, if hand-in-glove with fresh science, technology, math, and engineering (STEM) knowledge. Education, discovery and innovation are the troika pillars of 21st century progress. Coupled together, they offer the potential for an era of breathtaking transformation.

There is an old Japanese proverb that says, “None of us is as smart as all of us.” If we look at this in the context of today and what it means for education, we are beginning to see a fundamental shift. While educational organizations remain organized by disciplines and departments and in many cases isolated from the private sector, we recognize that we now need to view demarcations not as boundaries or barriers, but rather as junctures, one might say couplers, for connection and collaboration.

We are learning that these junctures are fertile places of opportunity. The questions in any discipline or organization can often be enlightened or even answered by knowledge from other disciplines and organizations. When we think as ‘communicators’ and ‘collaborators,’ disciplines and organizations are no longer regarded as separate fiefdoms with moat and drawbridge, but rather neighbors in a community. In truth, new knowledge is increasingly created at the interfaces of disciplines and organizations.

Collaborations and partnerships are proliferating, but we have scarcely begun to explore their potential. We have learned how to share information. But we have yet to understand deeply the factors that foster teamwork, let alone hone our ability for genuine collaboration that draws on the knowledge and experience of diverse partners. Recognizing this can change the whole sociology and dynamic of an institution and multiply its chances for ferreting out the best questions and getting answers, solutions, and success.

This partnering commitment is partly what compelled NSF to create its Math and Science Partnership (MSP) investment. The idea of the NSF MSP was to form merit-reviewed eclectic partnerships across the country with a focus on enabling students and teachers through partnership among faculty in the sciences, technology, engineering, and math (STEM) with school of education faculty and schoolteachers.
Let’s move the concept of “all of us” to another level – that of our nation’s demographics. As it has done a number of times in the past, America is going through a seismic population shift. By the year 2050, the U.S. will be a majority of minorities. Many of us are glib with this statistic but we are blind to its implications. The first thing to recognize is that this change is already in motion. It is a ‘fait accompli.’

This variety and diversity, the consequent differing perspectives of all, and the capability to morph for the good are the ingredients which make America great.

In today’s world, the ability to make sense of the complex is to value the perspective of diversity and inclusivity. This is a global competitiveness factor of high order. If we fruitfully employ the differences that diversity brings and mute the divisions, our country can remain intellectually and strategically formidable.

Thus, our growing diversity is a critical element of our future greatness. A demographic environment that is inexorably headed toward a majority of minorities who are not educated is a formula for failure in a nation that has continued aspirations of greatness. Our nation’s high school dropout rates are unsustainable in light of a job environment that requires not only graduates but astute graduates, who are intellectually agile and can meet the expectations of jobs that do not even yet exist.
Those among the ‘learned,’ and those among the ‘learners,’ need greater synergy to realize this goal. Do not let this opportunity, which I know you all see clearly, slip through your capable and supportive hands.

I urge you all to climb on the bandwagon. We need lots of hands, minds and hearts for this critical task. I know you agree with this goal but we really need to do it! This is once again the way that ‘all of us’ is better than one of us.

The unique value that diversity brings to our schools and, as a consequence ultimately to the societal marketplace, is the same value it brought to America throughout our history. A melting pot of cultures is the best assurance to produce a melting pot of ideas. It is that melting pot of ideas that brings innovation to the forefront.

The strength of a nation’s innovation power can be measured not only by the strength of its ideas but also its willingness to take risks to make gains. America has always been seen as a country of ideas. From the founders’ concept of democracy, with its balance of powers and an independent judiciary, to the concept of self-made-success or what we call the American dream, our nation has valued new ideas.

Franklin being perhaps the greatest innovator among our nation’s very innovative founders, we keep re-visiting many of his ideas. As a scholarly thinker, Franklin produced comprehensive knowledge, everything from discovering the universal nature of electricity and laying down its principles, to charting the path of the Gulf Stream, to recognizing the risk of lead poisoning.

However, it was Ben’s devotion to the idea of the public good that drove his most intense creativity. He orchestrated the creation of America’s first lending library, fire company, and fire insurance company. He organized projects to pave, clean, and illuminate the streets of Philadelphia at night. He proposed a police force that would be paid out of general taxes. He refused to take a patent out on the Franklin Stove in order to make it available to everyone.

And within this realm of the public good, he proposed an integrative kind of education in his scholarly paper, Proposals Relating to the Education of Youth in Pennsilvania, 1749. When reading the curriculum he mapped out, one can see that the intent was to ensure that graduates, in today’s terms, would be math literate, science literate, tech literate, economy literate, language literate, socially literate, … in other words, holistic for the times to come, which he referred to as “future circumstances.”

The phrase "future circumstances" is cool because it emphasizes educating the kids for what we do not yet know may come. Further he evoked, “that though the American Youth are allow’d not to want Capacity; yet the best Capacities require Cultivation, it being truly with them, as with the best Ground, which unless well tilled and sowed with profitable Seed, produces only ranker Weeds.” He introduced this point quoting a poem by Thompson that Ben puts forward as defining "the useful culture of young minds:"
'Tis Joy to see the human Blossoms blow,  
When infant Reason grows apace, and calls  
For the kind Hand of an assiduous Care;  
Delightful Task! to rear the tender Thought,  
To teach the young Idea how to shoot,  
To pour the fresh Instruction o' er the Mind,  
To breathe th' enliv'ning Spirit, and to fix  
The generous Purpose in the glowing Breast.  

With this 1749 paper, Ben’s goal was to make students aware of the relationship between knowledge and learning, and the environment in which they lived and could serve. In his words: “The idea of what is true merit should … be often presented to youth … as consisting in an inclination joined with an ability to serve mankind, one’s country, friends and family; which ability is … to be acquired by true learning; and should be the great aim and end of all learning.” What a goal to help propel a nation in nascence.

Martin Luther King added to this task the boldness of moving together audaciously with true commonweal. And we count now on our new President to lead us in forming this more perfect union. And, yes, we gotta help him! And yes we can! And yes we will!

Today’s world is powered by magical tools and systems. A mouse click can take you anywhere, even to outer space. Making connections to learn is now a robust reality. These new capabilities promise to shape and benefit the way we live, work, and progress. The world is ‘turning rapidly on its axis.’

Indeed, from 30 tons to having the whole world in our hands and under everyone’s thumbs is a reality, and as we think about change at a moment in history where places are no longer remote, and people are never disconnected, we must learn to anticipate and guide change, instead of merely being victims of the process -- with some winners and many losers. The speed of change is so great that we must rethink the way we educate in order to enable a whole society to flourish in the wake of the new velocity of change.

There is an old Icelandic saga that depicts a character named Snorri as “the wisest man in Iceland without the gift of foresight.” At first thought, that might seem contradictory. At reconsideration, it tells us something very important. Snorri had an abundance of information or knowledge, making him a good candidate for ‘Jeopardy,’ but he couldn’t connect the dots to anticipate the future. He was encyclopedic but not insightful. He could relate information but he couldn’t envision its consequences.

No one but mystics and psychics claim to be able to predict the future, but learning how to anticipate the future, and thus prepare for the new patterns, trends, and paradigms, is critical. Without thinking, we all use the expression ‘an idea whose time has come.’ It is not really that the time is proper for the idea, but rather that we are ready to engage the idea. If we learn and practice the mindset of anticipating the future, I think we will discover fewer pitfalls and more promise.
We must learn to live in a mindset of outreach to embrace new ideas--in our schools, our communities, our nation, and the world. Since today’s sophisticated transportation and communication have reduced most of our planet to a day’s journey or a mouse click, we are all neighbors. But we haven’t figured out how to assimilate that leap-in-time, and proximity, so we can integrate changes together in new ways. That would be the ultimate innovation.

The changes in our proximity to each other are surely noticed but not assimilated into how we live together. We need to re-think the concept of education for a world transformed by revolutions in knowledge, technologies, economies, life expectancies, environments, and families. No matter our training and position, we must be ‘learners’ as well as ‘learned.’ In many ways, our children and grandchildren will be our educators.

We have no shortage of ideas and we possess inexhaustible drive. The more we learn about the exquisite balance of the Earth’s natural and human-made systems, the more we discover about human interaction and learning, the more we comprehend how institutions work, the more we will be able to navigate these complexities, embrace technology appropriately, and see new possibilities to create positive outcomes.

In this context, perhaps the most important sentence in Friedman’s “flat world” is, “The greatest challenge for our time will be to absorb these changes in ways that do not overwhelm people but also do not leave them behind.” In other words, as we move ahead, we must act intelligently and cultivate a benevolent approach to robust change.

If this all sounds a little bit overreaching, think of it in terms of a workable system we enjoy in a flexible society – that is, in Vannevar Bush’s words, "... the free play of initiative of a vigorous people under democracy... [supported by] the advance of science and its application.” For example, the idea of browsing (without which there would be no web) that led to Mosaic and then Netscape, was seeded by an NSF-supported graduate student working in a computer center funded by NSF within an infrastructure known as NSFnet. This flexible, open, free play of initiative by a vigorous human being with a good K-12 education changed the world. It happened in America.

Change and complexity are the rule in our contemporary world, a world transformed repeatedly by the interaction of new knowledge and new technology, a world linked globally, where differences in how we think can enhance progress and divisions in how we act can destroy it. Possessing the acumen of STEM and recognizing societal needs compel us to bring innovation face to face with human intent. If we are true to our Constitution, we do not settle for understanding alone, but insist on using knowledge to shape a better future.

I want to emphasize, especially since it is your tax money that is being used, that the centroid of NSF’s investment in all its grants and awards is to develop a world class science and engineering workforce. The initial spark that motivated the President of the United States in directing Vannevar Bush in 1944 to study the possibility of an NSF was his determination that the 15 million citizens in uniform returning from the end of WWII
would have jobs in peacetime. Dr. Bush observed that creating so many jobs required the development of new industry built upon new discoveries made by educated people through scientific frontier research. His report to the President, titled *The Endless Frontier* asserts, “… in the last analysis, the future of science in this country will be determined by our basic educational policy.” He also presaged today’s focus on broadening participation by noting in his Report, “If ability, and not the circumstances of family fortune, is made to determine who is to receive higher education in science, then we shall be assured of constantly improving quality at every level of scientific activity.”

Well, where is the next innovation coming from if our country does not meet the challenge of mining the “silver” and diffusing knowledge amongst the peoples, all of them?

Talent runs deep in America, in broad streams of intellect, perspective, and culture. We possess tantalizing potential, but we have not yet learned how to help all individuals realize their promise: we have not been totally inclusive. When we understand that diversity and inclusivity are the lifeblood of progress and prosperity, it becomes the nation’s responsibility--and that includes all of us. Every sector and every citizen has something to offer. We will realize our goals sooner if we all work together in harmony.

It is the varied, richly textured and shaded fabric of diversity and inclusivity--not any single thread--that provides durability and strength to our science and engineering enterprise--and thus to our nation. Diversity--once given scope and opportunity--has the potential to shape, to transform, and to drive our future for the better.

I applaud each of you and all of you for your innovative creativity, for your wisdom in seeing the value of coupling disciplines across their interfaces, for your commitment to making the STEM enterprise an inclusive and integrative endeavor, and for your determination to see the job through.

As President Obama said on Tuesday, “Yes we can and yes we will.”

And, yes, knowing what the “this” is in “we can do this,” we CAN do THIS.