Statement from Mariette DiChristina, editor in chief and senior vice president, *Scientific American*.

Thank you, honorable members of the Senate Subcommittee on Commerce, Science and Transportation, for the privilege of addressing you today about the importance of science and science education.

My name is Mariette DiChristina, and I'm the editor in chief and senior vice president of *Scientific American*, the oldest continuously published magazine in the United States. It was founded in 1845, during the Industrial Revolution in the U.S. To foster innovation, *Scientific American* started the first branch of the U.S. patent agency in 1850. Samuel Morse, inventor of the telegraph, and Elias Howe, inventor of the sewing machine, were among the scientists and inventors who visited the offices. Thomas Edison showed the editors his phonograph. It asked them: "How do you like the talking box?" Albert Einstein wrote an article for *Scientific American*, as have more than 150 Nobel laureates and many winners of the National Medals of Science and Technology given by the White House.

Despite its name, it's not a magazine aimed at scientists, although I'm pleased that some of them read it, too. Business leaders make up more than 50% of its audience of more than 3.5 million in print more than 6 million online—and nearly 20% are C-suite, looking to science for ways to grow their businesses. Of the 200 titles measured by MRI, it is number 6 for "Influentials." Educators, students, policy leaders and science enthusiasts read *Scientific American* for innovation insights.

At the same time, *Scientific American* has always had an educational mission to share the value and wonder of science. A subscription cost $2 a year in 1845, but in the first issue the editors promised it would be worth "five times its cost in school instruction." The magazine detailed the research and technologies that won World Wars I and II, the great space race that landed U.S. men on the moon 45 years ago yesterday, the rise of computer science and electronics that have today transformed our lives in the modern world, among other things.

Science is the engine of human prosperity. Economists have said that a third to a half of U.S. economic growth has resulted from basic research since World War II. The cars and trains that got us to this building, the smart phones we are all carrying, the energy we are using to run the lights in this chamber, the clothes we are wearing, the food we eat: All of these things were developed through the process that we call science. And before the conveniences that we enjoy today existed, researchers had to pioneer the basic concepts that provided a sound foundation for those applications—and they did that pioneering not necessarily knowing where it would lead. I know Einstein wasn't thinking about the conveniences we enjoy from GPS in our smart phones when he formulated his theory of

relativity a hundred years ago, for instance. But knowing how spacetime works helps make our measurement from orbiting satellites accurate.

For all of these reasons, we need to make it a national priority to provide steady and sufficient support for basic research in science, and to STEM education and public outreach. We need to take the long view on R&D investment for the nation's continued future wellbeing, just as we need to nurture, educate and inspire our children over their K-12 careers so that they can succeed in an increasingly competitive global marketplace.

Successful basic research takes careful work and patience. Typical funding grants are five years long. It takes time to run the experiments, gather the data, analyze it properly, and confirm the findings. Conducting basic research properly also means following human curiosity and exploring questions that may not have immediately obvious answers or applications.

But our own U.S. track record of federal investment shows that there is an important relationship between steady investment in that R&D and our success in innovation and economic growth. U.S. federal funding was key to nearly 90 percent of almost 100 top innovations from 1971 to 2006 identified by R&D Magazine, for example. Federal funding at DOE led to such innovations as the optical recording technology that lets us enjoy DVDs; the communications satellites that help us send information around the world, modern water-purification systems and supercomputers. NSF funding for a couple of students got us Google and also new technologies used in industries including biotech, advanced manufacturing and environmental resource management. DARPA's basic research led to GPS, the Internet, and Siri on iPhones. It's so easy to go on and on.

Our success in addressing many of the key issues that face the nation today, from ensuring our energy security to providing healthy foods to medical advances to cure illnesses to our ability to live well and sustainably in a finite world, will turn on the innovations that arise from basic science research.

Basic research also provides a good direct return on investment. A report by research firm Battelle Technology Partnership Practice, for instance, estimates that between 1988 and 2010, federal investment in genomic research generated an economic impact of $796 billion compared with $3.8 billion spent on the Genome Project between 1990-2003 amounted to $3.8 billion. That's an ROI of $141 for each dollar invested.

So today we are benefitting from past R&D investments. But our preeminence requires constant vigilance. The U.S. is still dominant in global research but our investments have flattened and declined in real dollars since the 1980s according to a report from the Congressional Budget Office on R&D and Productivity Growth. Because of the length of time needed for basic research, also, the Sequester cuts will affect progress for years to come in forestalled and canceled work. Meanwhile, countries such as China are fast nipping at our heels. China's rate of GDP investment earlier this year surpassed that of the 28 member states of the European Union, and it is on track to exceed that of the U.S. itself in a little over half a decade, according to the 2014 Global R&D Forecast by

Battelle and R&D Magazine. Japan, Denmark, Finland, Germany, Israel and Sweden already spend a greater percentage of their GDP on R&D than the U.S., according to World Bank. Germany's strategy to boost economic growth has been to increase investment, lifting its own federal expenditures by 21 percent since 2005. These investments played an important role in Germany's 3.6 percent growth in 2010 compared with 2.9 percent growth rate in the U.S. during the same time period.

The STEM pipeline in education is also critically important to that economic wellbeing. Seventeen of 20 of the fastest growing jobs for the next decade are in STEM-related fields, and our leading technology companies are often challenged in trying to fill the necessary openings.

So basic research helps benefit our wellbeing, the nation's economic growth, and the creation of jobs. It's also increasingly inspiring to the public who can now engage with it directly thanks to digital platforms. Although the headlines about celebrities don't show it, we know well at *Scientific American* how basic research has captured the public's imagination. Let's look the grass-roots level. We see two groundswells in participation by hundreds of thousands of people in enthusiasm around citizen science and the maker movement. Citizen scientists are people like you and me who can help scientists conduct basic research by making observations or in other ways. The Zooniverse Web site, for instance, lets anybody catalog heavenly objects from NASA images. The Zooniverse has more than one million volunteer citizen scientists! *Scientific American*'s own Whale.FM citizen-science project, which lets you match up snippets of whale songs, in two months catalogued more than 100,000 such calls—equal to a couple of years of work by lab researchers. Volunteers using the FoldIt protein-folding online game recently solved a puzzle that eluded HIV researchers for 15 years. And the Maker movement is such a phenomenon that the U.S. Office of Science & Technology Policy is holding Maker Faire events.

For one more viewpoint on the value of basic research, I thought I'd turn to a member of the next generation. I told my older daughter, Selina, who plans to double major in computer science and graphic design, that I would be speaking about this topic. I asked her what she would say about why science is important. How could I explain its importance, I asked her?

"That's easy, mom," she said to me. "It's the foundation of everything."

And so it is. Science is not a set of facts or received wisdom that's been handed down. It's a system for innovation and advancement—and humankind's best invention yet for pursuing the truth and an understanding of how the world works. It can fuel our economic growth as a nation, and form a path for our young people in a competitive global marketplace. And science can fire our imagination.

It can bring out the best in our nation and in us. That's why basic-science research needs our steady commitment and investment. Thank you for your kind attention.

References and Further Reading

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