Testimony of Steven Knapp
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Mr. Chairman, Members of the Committee:

Thank you for inviting me to testify this morning. As you may know, Johns Hopkins has been engaged with the innovation issue for a number of years – primarily through the efforts of our president, Dr. William R. Brody, and most recently through his work on the National Innovation Initiative with Intel Corp.'s chairman, Dr. Craig Barrett. I am pleased to have the opportunity today to share our University's perspective on this important issue.

The United States has long been the world leader in scientific discovery, thanks largely to government policies that encourage innovation, improve education at all levels, and facilitate the transfer of knowledge from the laboratory to the marketplace. Today we face serious threats to this preeminence. Other nations bring to the table strong educational systems, focused government policies, and low-cost workers. Asian and European countries are committing unprecedented resources to science and engineering programs.

Basic research is essential to our ability to meet this challenge. President Brody puts it this way: "Knowledge drives innovation. Innovation drives productivity. Productivity drives economic growth." Our ability to compete in the global economy depends, first and foremost, on our ability to continue making new discoveries. The more we learn about how things work – the principles of basic biology, chemistry, physics, and mathematics -- the more opportunity we have to put that knowledge to use. When we know more, we can use that knowledge to make our world better, to build new businesses and devise new products, and to improve our standard of living.

America's most innovative industries are built on decades of basic research, research that had no discernable practical application at the time it was undertaken. No practical application, that is, until a light bulb went on in someone's head; until someone said, "I can use that to make something."

For example:

* The highly theoretical world of quantum mechanics spawned the semiconductor industry and the information revolution.

* Johns Hopkins scientists thinking about the principle of physics called the Doppler effect used it to invent what became today's Global Positioning System.

* Two Johns Hopkins biologists shared a Nobel Prize in 1978 for using restriction enzymes to cut DNA into fragments. Had that esoteric basic research not been done, we would not today have a thriving biotechnology industry in this country.

* And what about CDs and DVDs? You would still be using vinyl and videotape if it were not for lasers, the roots of which go back to theoretical work by Albert Einstein.

In the United States, funding basic research has long been a governmental function. Why? Because it takes a long time to do it, because there is always a risk that any single project will come to nothing, and because it is difficult to capture an immediate return on investment in an idea that has not yet been developed to the stage of a marketable invention.

Despite a societal consensus that basic research is a government responsibility, however, U.S. federal research and development spending, as a percentage of gross domestic product, peaked *forty years ago*, in 1965, at just below 2 percent of GDP. In the past 40 years, that percentage has diminished by more than half, to about 0.8 percent of GDP. Overall R&D spending, especially in basic sciences, continues to decline.

We must reverse this trend now, by strengthening the nation's commitment to science-related federal agencies and programs, particularly the National Science Foundation, the National Institutes of Health, the Department of Energy's Office of Science, the National Aeronautics and Space Administration, and the Department of Defense's basic research programs.

Research and Innovation at American Universities

The Johns Hopkins University is the nation's leading recipient of federal research grants. In FY 2005, our researchers attracted $1.28 billion in federal R&D funding and $1.44 billion in overall R&D funding, a category in which Johns Hopkins has led all U.S. institutions for 25 consecutive years. This support allows us to improve medical care worldwide, advance human knowledge, and train new generations of innovative researchers.

But investment in research universities like Johns Hopkins yields tangible economic benefits as well. In FY 2004, Johns Hopkins alone produced 89 patents, filed 402 new patent applications, and generated $6.3 million dollars in income from technology licenses. That same year, our friends at the University of California won 270 patents; MIT won 159 and CalTech 142. In all, there were more than 3,200 patents issued to U.S. universities. That is a tremendous amount of knowledge made available to American business for commercialization and to the American public for an incalculable range of benefits.

Here are just a few recent examples from my own institution; my counterparts at other major research universities, were they here today, would provide examples equally illustrative of the point:

* Johns Hopkins has filed for a patent for self-assembling cubes, the size of a speck of dust, that can carry medicine into the body. These devices, which come out of an NIH-funded collaboration between engineers and radiologists, open up possibilities for the pharmaceutical industry for a new generation of "smart pills" aimed directly at a diseased or injured part of the body.

* The Johns Hopkins Applied Physics Laboratory has greatly improved molecularly imprinted polymers, or MIPs. These are special materials that can be tailored to detect specific chemical substances. We are now working with a startup company to develop products using this patented technology to improve drinking water and treat wastewater.

* Thanks to the licensing of our technologies to industry, one company outside Baltimore sells thin films that weld materials together in thousandths of a second. Another is developing products to improve the detection of explosives.

* There is a company using Johns Hopkins technology to analyze bone health. Another is using technology originally created to detect submarines to analyze instead the sound of the beating human heart.

Renewing our Commitment to Basic Research

Johns Hopkins strongly supports efforts to secure the competitive strength and national security of the United States by bolstering the nation's ability to innovate. The National Innovation Initiative, the National Academy of Sciences report *Rising Above the Gathering Storm*, President Bush's American Competitiveness Initiative (ACI), the National Innovation Act, and the Protecting America's Competitive Edge (PACE) Acts: each of these welcome efforts has helped to get the issue of basic science and innovation on the table for discussion and debate. Each envisions increased support for federal science agencies. The ACI, for example, calls for increased funding for programs at the National Science Foundation, the Department of Energy's Office of Science, and the National Institute of Standards and Technology.

As we engage in this discussion, it is crucial to stress that the physical sciences should not be funded to the exclusion of the life sciences. Today, biologists, statisticians, physicists, engineers, and computer scientists all work together to advance the knowledge we need to solve our most important problems.

Unfortunately, we tend at any one time to favor life sciences over physical sciences or vice versa, starving one to feed the other. That must not happen. The nature of scientific innovation today means that starving one starves both.

The basic life sciences research funded by the National Institutes of Health is a key component of our overall national science agenda. This fiscal year, spending for the NIH has been cut $66 million. This was the first cut to the NIH since 1970. For FY07, the President has requested $28.43 billion -- essentially a freeze at the current level. And the number of new NIH grants has already tumbled nearly 15 percent from its peak in 2003, hobbling the ability of scientists to open up new lines of investigation.

Last year, with the support of the NIH, Johns Hopkins established the nation's first Institute for Computational Medicine, staffed by biomedical researchers and physical scientists from our School of Medicine and School of Engineering. Using powerful information management and computing tools, research teams will mine data, model molecular networks, identify biomarkers of disease at early stages, and find new and more effective ways to treat disease.

As NIH funding erodes, we are concerned that projects that meld physical and biological sciences, such as work of the Institute for Computational Medicine, could be among the first to suffer. These projects provide a vital foundation both for medical advancement and for innovation, the kind of innovation that leads to economic growth. They should be supported.

Visa Policy

Return on our national investment in basic research will be most fully realized only if universities can continue to attract the best and brightest from around the world. Research universities have relied on open visa policies designed to promote international intellectual exchange. But today, delays and difficulties in obtaining visas to the United States have contributed to a declining in-flow of scientific talent. At Johns Hopkins, for instance, the number of graduate students from China declined from 328 in 2001 to 178 in 2004. The number of foreign undergraduate students of all nationalities has dropped from 381 in 2001 to 257 in 2004.

Competitor nations, meanwhile, are quite naturally taking advantage of our increasingly cumbersome visa process to lure top talent away from the United States. And with the strengthening of foreign science, there are many attractive substitutes abroad for U.S. degree programs, fellowships, and academic conferences.

No question: it is critical that federal policy protect our national security. At the same time, however, we must foster an environment favorable to international students and scholars. Immigration policies should make it easy for the best and brightest to come here, to stay here, and then to live and work here when their studies are complete. Johns Hopkins supports government policies and contracting practices that facilitate rather than hinder participation by international students and scientists in the conduct of unclassified fundamental research.

K-12 Education

Neither strong investment in research nor participation from abroad will preserve America's competitive edge in the long term if we do not repair our faltering K-12 education system, especially in the areas of mathematics, science, engineering, and technology. Advanced research at universities can only be built on a foundation of basic education.

Since 1980, America's non-academic science and engineering jobs have grown at more than four times the rate of the U.S. labor force as a whole. But in the same two and a half decades, the performance of K-12 students in science and mathematics has declined. According to figures cited by the Association of American Universities, U.S. fourth graders score well against international competition in math and science testing. By the 12th grade, however, our students have fallen to near the bottom.

This weakness also shows up at the postsecondary level. In 1966, American-born students earned 77 percent of science and engineering Ph.D.s awarded in the United States, while foreign-born students earned 23 percent. In 2000, it was 61 percent for U.S.-born students and 39 percent for those from abroad.

At Johns Hopkins, we are able to attract and enroll well-qualified students, but our elementary and secondary education experts' work with schools around the country reminds us daily that the problem of deficient K-12 education in math and science must be addressed -- and soon.

Colleges and universities are stepping in to help. At Johns Hopkins, we provide enrichment for talented students and programs to attract young people into science and technology careers. We help schools reform their curricula. We work to train new teachers, including scientists or engineers looking for a second career.

But government action is obviously needed as well.

The National Innovation Act, the Protecting America's Competitive Edge Acts, and President Bush's American Competitiveness Initiative all address this problem. I would like to thank Senator Ensign for his leadership on these issues, and for introducing, with Senator Lieberman and others, the National Innovation Act (S. 2109). This legislation is an important step toward solving many of the issues before us today. I hope that we will continue to see bipartisan cooperation, both here in the Senate and in the House, on all these proposals.

I would like to offer two examples of what can be accomplished by strong K-12 programs. Ryan Harrison and Abe Davis are two incredibly gifted and successful Baltimore students. Both were enrolled in Baltimore Polytechnic Institute's special foundation-funded "Ingenuity Project" for gifted math and science students. Both

worked with some of the city schools' most accomplished teachers; both received dedicated and generous mentoring from Johns Hopkins researchers.

Thanks to their talent and these advantages, Ryan and Abe were able to make extraordinary advances while they were each just 17 years old. Ryan, working in a chemical and biomolecular engineering lab at Johns Hopkins, extended the abilities of a molecular biology program called Rosetta. He wrote code late into the night until he had come up with a way to predict protein behavior at varying pH levels. Abe also invested impossible hours in his project, building an immensely complex computer graphics model of the thousands of bounces and collisions that result from dropping scores of balls into a box.

Someday, Ryan's work may help make it possible to create antibodies customized to fight a particular patient's cancer. Who knows what startling uses medical researchers, scientists, and engineers might find for Abe's computer simulation technology?

Both Ryan and Abe are winners in Intel's Science Talent Search. Ryan is now a student at Johns Hopkins and part of our Baltimore Scholars Program, which provides full scholarships to graduates of Baltimore’s public high schools who earn admission to the university.

Unfortunately, these successes are far from the norm. The kinds of advantages Ryan and Abe enjoyed simply are not available in the classrooms of most American students, including many of those with real math and science talent. Students from disadvantaged backgrounds have been especially shortchanged.

From early childhood and pre-school education through high school, there are heroic, but isolated, efforts under way around the country to better prepare the children of America to make the discoveries and technological advances that will save lives, improve living, and drive the economy forward. Those isolated efforts, however, must become systemic and must be backed by the resources and political will that can make them effective.

Unless we act, stories like Ryan Harrison's and Abe Davis's will remain nothing more than happy exceptions.

Conclusion

Thank you for your efforts to strengthen American competitiveness. If we at Johns Hopkins can assist you in this important endeavor, please do not hesitate to contact us. I invite you and your staff to visit our campuses, explore our facilities and meet our researchers face to face. You will find no more persuasive argument for the inestimable value of investment in research than witnessing the innovative enterprise firsthand.

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