Testimony Before the Subcommittee on Research and Science Education Committee on Science and Technology U.S. House of Representatives

"Federal STEM Education Programs: Agencies' Perspectives"

Statement of

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Chairman Baird and members of the committee, it is a privilege to accept your invitation to participate in this hearing and provide you with information about STEM education efforts at the National Institutes of Health (NIH), an agency of the Department of Health and Human Services.

The mission of the NIH is to uncover new knowledge that will lead to better health for everyone. NIH has long been involved in directing programs for the collection, dissemination, and exchange of information in medicine and health, including the development and support of medical libraries and the training of medical librarians and other health information specialists. In 1991, the NIH formed an Office of Science Education Policy (now the Office of Science Education under the Office of Science Policy) in the Office of the Director because of concerns surrounding the state of science education in the nation.

The NIH Office of Science Education (OSE) coordinates a program to strengthen and enhance efforts of the NIH to attract young people to biomedical and behavioral science careers and to improve science literacy in both adults and children. The function of the OSE is to: 1) develop, support, and direct program activities at all levels, with special emphasis on targeting students in grades kindergarten to 16, their educators and parents, and the general public; 2) advise NIH leadership on science education issues; 3) examine and evaluate research and emerging trends in science education and literacy for policy making; 4) work closely with the NIH extramural, intramural, women's health, laboratory animal research, and minority program offices on science education special issues and programs to ensure coordination of NIH efforts; 5) work with NIH Institutes and Centers to enhance communication of science education activities; and 6) work cooperatively with other public- and private-sector organizations to develop and coordinate activities.

NIH contributes to K-16 STEM education in three main ways: 1) by partnering with educators on high-quality model programs to create instructional materials, conduct teacher professional development, and support informal science education in museums and science centers; 2) by conducting rigorous research into science and mathematics learning and teaching through NIH's National Institute of Child Health and Human Development (NICHD); and 3) because of its interactions with scientists and students from around the world, by helping to understand the "world class standards" our students will need to compete in today's world.

1a. What steps has your agency taken to improve its coordination with other federal agencies' STEM education activities?

NIH was actively engaged in the Academic Competitiveness Council (ACC) deliberations. NIH Director Elias Zerhouni joined the ACC at the invitation of Secretary Spellings and made clear his support for the process. NIH participated in all three ACC working groups: K-12, Graduate/Postgraduate, and Outreach and Informal Education.

Dr. Zerhouni has also committed NIH to a leadership role on the new National Science and Technology Council (NSTC) Subcommittee on STEM Education that will follow through on the ACC recommendations. Dr. Zerhouni appointed Dr. Duane Alexander, NICHD Director, to serve as one of the co-chairs of the subcommittee, along with Dr. Cora Marrett, National Science Foundation, and Dr. Russ Whitehurst, Department of Education.

Additionally, the NIH is in discussions with the Department of Defense and the National Aeronautics and Space Administration (NASA) about ways to extend the ACC database (ACC Recommendation #1). By expanding the program database to include project-level information, federal program managers with shared interests (e.g., teacher professional development) would be able to find one another in order to share information.

1b. To what extent does your agency collaborate with educators in the states and school districts in developing STEM education programs?

Some of the resources that teachers request from the NIH were not originally targeted for classroom use. Most of the large number of publications created by NIH are directed to specific health conditions or are directed at specific audiences, such as patients, family members, and healthcare professionals. However, once these publications were discovered by science teachers, they began to be requested for use in classrooms as well. (Two popular examples are of this type of publication are *Inside the Cell*, available at http://publications.nigms.nih.gov/insidethecell/, and *Understanding the Immune System*, at http://www.niaid.nih.gov/publications/immune/the_immune_system.pdf.)

However, today the majority of NIH programs and resources requested by educators were created expressly for, and with, teachers. Below are two examples of NIH resources currently available to science educators.

First, the NIH National Center for Research Resources Science Education Partnership Award (SEPA) Grant Program is the largest single K-12 (and informal) science education program at NIH. SEPA's goals are: 1) to stimulate career opportunities in basic science and clinical research

by providing inquiry-based curricula to K-12 students, teachers, and parents; and 2) through SEPA projects at science centers and museums, to increase the public's understanding of NIH-funded medical research and to provide information about healthy life style choices. Because these awards are made to a community organization, the projects can be specifically designed to meet the needs of that community. For examples of SEPA-funded projects in selected States, see Appendix A at http://science.education.nih.gov/HSTC, and for additional information about SEPA, see http://www.ncrr.nih.gov/science_education_partnership_awards/.

Second, OSE has collaborated with a number of NIH Institutes and Centers to create a series of free curriculum supplements (currently 16 titles) for science educators (available at http://science.education.nih.gov/supplements). Teachers have input into the development, writing, and editing of each supplement. The supplements are field-tested by teachers across the nation and modified to address their concerns before being released to the public. Our state-level collaborations have included working with state departments of education and state-wide education advocacy groups (in New York, North Carolina, Ohio, Missouri, and Tennessee) to determine whether a supplement meets a need in the state-wide science curriculum and to help with state health education standards development. The North Carolina Department of Public Instruction has recommended one of the NIH supplements as a primary resource for their eighth-grade science teachers since 2005.
(http://www.dpi.state.nc.us/docs/curriculum/science/middlegrades/8thsciencesupport.pdf.)

2. The recent report of the Academic Competitiveness Council reinforces the need for better evaluation and performance metrics for federal STEM education programs. What plans does your agency have for improvements in its evaluation of its STEM programs?

NIH supports the ACC goal of conducting increasingly rigorous evaluations of its STEM education activities using multiple evaluation strategies. These strategies will include working toward conducting randomized controlled trials where appropriate.

NIH has agreed to align its goals and metrics to those defined through the ACC process. The first NIH-wide meeting of K-12 project directors was held in April 2007 to discuss this alignment as well as ways to begin collaborating on increasingly rigorous evaluations.

The science education grants programs at NIH (for example, SEPA grants) are currently considering changes in their funding opportunity announcements to require increasingly rigorous project evaluations. While this process will take some time, OSE is committed to helping the community (extramural grantees and NIH intramural project managers) solve the problems it may encounter on the road to rigorous evaluations.

3. The Subcommittee received testimony at a hearing on 15 May on how the R&D mission agencies could improve the effectiveness of their STEM education programs. The witnesses were skeptical of the ability of the agencies to develop curricular materials for formal classroom instruction and questioned the effectiveness of their teacher professional development programs to improve teacher classroom performance, while suggesting that the agencies' most important role is in informal STEM education. The witnesses also strongly recommend closer collaboration by the agencies with educators in the field when developing STEM programs. What is your response to the recommendations from these witnesses?

Several witnesses expressed concerns at the May 15 hearing regarding the potential pitfalls related to developing curricular materials for formal classroom instruction. Mr. Michael Lach made comments about the problems of *"adding more topics to cover"* and of parochial projects' being *"harder to connect to our work"* in terms of curriculum materials. Dr. Nelson noted,

"There is a huge inventory of poorly designed and under-evaluated mission-related curricula (posters and lesson plans and associated professional development) rarely used in classrooms and with no natural home in a coherent standards-based curriculum. Effective curriculum development requires a deep collaboration with a team of professional curriculum developers, education researchers, and classroom teachers."

We could not agree more. Development of high-quality instructional materials is a difficult, time-consuming, and expensive undertaking. It is true that well-meaning scientists have unwittingly added to Dr. Nelson's "huge inventory of poorly designed and under-evaluated" curricula. We believe that OSE has avoided these pitfalls by proceeding slowly, doing our homework, understanding where we have expertise, and, most importantly, understanding where we do *not* have expertise.

Before starting the NIH Curriculum Supplements Series, we conducted nearly two years of research, discussions, and interviews with leading curriculum developers across the U.S. We also conducted focus groups with educators at a number of conferences around the nation to determine whether there was interest in having NIH create supplemental materials for the classroom. (There was.) We discussed with educators the topic areas where they felt they needed help and how these might be fit into biology courses. Interestingly, the teachers also strongly warned us "not to let our scientists write the curricula," advice that we took to heart.

When considering what NIH can bring to the creation of supplemental instructional materials, it is important to note that our employees include some of the world's leading scientific minds. Dr. Anthony Fauci, Director of the National Institute of Allergy and Infectious Diseases, and Dr.

Francis Collins, Director of the National Human Genome Research Institute, are only two such individuals who have contributed their scientific understanding and foresight to the NIH Curriculum Supplements Series. However, while NIH has this kind of scientific expertise in abundance, we do not have in-house expertise in instructional materials development.

Instead, we have sought out professional curriculum development organizations that are as well known and respected in their field of expertise as NIH is in its own. We have contracted with BSCS (Biological Sciences Curriculum Study) and EDC (Educational Development Corporation), two of the most highly respected science instructional materials developers in the nation. Both of these organizations rely on research into how children learn science, use professional curriculum developers, and depend on classroom teachers as advisors, writers, and field-testers. Both of these organizations trace their genesis back to the early post-Sputnik days and have established long track records of creating innovative and effective curricula.

NIH curriculum supplements were designed from the start to align with the National Science Education Standards (NSES). Most States have used the NSES to create their own standards documents. Since implementation of the No Child Left Behind Act, alignment to the NSES is no longer sufficient. As a result, we are undertaking the task of aligning each of our 16 curriculum supplement titles to each state's science, mathematics, health, and language arts standards (34 States and the District of Columbia are done so far; see Appendix B at http://science.education.nih.gov/HSTC for samples of alignments of one supplement to selected States). When this project is complete, we will be able to demonstrate for each state how a specific NIH curriculum supplement directly addresses the science and cross-curricular content standards that educators are expected to cover.

Many educators have reported being especially excited to receive materials that can transmit some of the thrill and sense of discovery arising from the latest NIH research as a way to inspire and motivate their students. Each supplement provides activities for students to investigate science content knowledge they can apply directly to some aspect of their daily lives. The fact that the materials cover the biological concepts that teachers are required to cover but do it through references to human health and disease is seen as a strong positive. For instance, in general, children do not get very excited by studying onion root tips. It is far more engaging to study the mechanisms that control cell growth by relating it to a human disease like cancer.

In creating these instructional materials, we were also motivated by the fact that research into the poor performance of our students in international comparisons has concluded that curricula in the U.S. are "a mile wide and an inch deep" and that content is often years out of date. The American Association for the Advancement of Science Project 2061 has evaluated many middle and high school science textbooks and found all of them wanting. None of the 10 evaluated high school biology textbooks received even a "good" rating. We were convinced that teachers would benefit from free, accurate, interesting, standards-based instructional materials that incorporate the latest research into how people learn, so we developed curriculum supplements that allow students to think like present-day researchers and engage in practical applications.

The extent to which we have created a curriculum series that is of interest to educators is indicated by the fact that as of late May 2007, more than 70,000 educators have requested almost 285,000 supplements across the Nation. We would like to emphasize that *each of these supplements has been shipped out in response to a specific request for that title coming in from*

an educator. In other words, each of these requests is a record of a positive action taken by an educator to come to our website, fill out a post card, send us an e-mail, etc. (See Appendix C at http://science.education.nih.gov/HSTC for distribution maps showing how many, and from where, requests have come for selected States.)

We are also proud to report that NIH curriculum supplements are frequently used as exemplary instructional resources by university-based professors engaged in teaching future science teachers in "methods" courses. The middle school supplement *Doing Science: The Process of Scientific Inquiry* has been especially well received by this audience. To our knowledge, very few other entities have created educational materials that are deemed so useful that they are requested both by STEM teachers and by the university-based professors who train them.

We created the NIH curriculum supplements as models for how challenging content can be combined with engaging, realistic situations to give students the opportunity to *think* like scientists. For a report on how the instructional model underpinning the NIH curriculum supplements aligns with current research into how people learn, see Appendix D at http://science.education.nih.gov/HSTC.

Last, although we share an enthusiasm for informal science education, we are concerned by the inequities that would result if it were our only approach. Many educators, particularly those in small, rural, or impoverished urban school districts, cannot afford a field trip to a science center or museum, nor is every school district within driving distance of a museum, major university, or federal laboratory installation. We must not forget those teachers and students who cannot, for financial or other reasons, travel to a wonderful science museum, or have a scientist visit the

classroom. These teachers and students also deserve to have access to high-quality science experiences.

I would like to illustrate this last point with a personal anecdote. I was one of those rare individuals who knew from early childhood that he wanted to be a scientist. Undoubtedly, this was due, at least in part, to the post-Sputnik efforts that allowed my parents to order me pictures of astronauts, rockets, and stars from NASA. However, living where I did in central Illinois, I was a senior in high school before I got to meet my first working scientist—after a four-hour bus ride to Argonne National Laboratory. We have designed the NIH curriculum supplements to bring some of the excitement, promise, and hope of NIH research to any school—urban or rural, rich or poor, with the best laboratory facilities or none at all.

4. How does your agency determine priorities for its K-16 STEM education portfolio? Has your agency's balance of programs at graduate/post doctoral, undergraduate, K-12, and informal education changed much over the past few years? Do you foresee a change in that balance in the future?

Approximately 95% of the education activities (in dollar terms) that NIH submitted to the ACC inventory fell into the "Graduate/Postgraduate" category. NIH has no plans to change that balance.

In the future, this priority setting will be more formal and coordinated. As previously mentioned, NIH has agreed to align its goals and metrics to those defined through the ACC process. The first NIH-wide meeting of K-12 project directors was held in April 2007 to discuss this alignment as well as ways to begin collaborating on increasingly rigorous evaluations.

5. How does your agency disseminate information about its STEM education programs? What organizations, both government and private, have you partnered with to reach educators in the field?

OSE has created a Web site specifically designed to help educators find NIH resources that meet their needs (http://science.education.nih.gov). We also responded to input from teachers regarding the ways that they search for materials (for example, by topic, by grade level, by resource format). As OSE identifies new NIH resources, it codes them using this scheme to facilitate easy retrieval by teachers.

Shortly before our last Web site redesign, we began using the evaluation services of the American Consumer Satisfaction Index (ACSI), which publishes an *e-government Satisfaction Index*. ACSI is a cross-industry measure of consumers' satisfaction. It measures the performance of over 200 private-sector companies as well as many government agencies, using scores calculated on data gathered from voluntary online surveys of randomly selected site visitors. For the past few years, the *OSE Web site has been one of the top 10 sites in the entire government in terms of customer satisfaction.*

Since March 2000, site traffic has increased from 17,000 visitor sessions per month to well over 250,000 visitor sessions per month. Web pages viewed each month have increased over the same time period from 36,000 to almost 2.5 million.

For the past two years, OSE coordinated an "NIH Research Zone" at National Science Teachers Association (NSTA) national conferences. This year, eight NIH Institutes and Centers joined OSE, along with the Society for Neuroscience and other organizations. This effort has been greatly appreciated by the NSTA members. NSTA President Linda Froschauer cited it as a good

example of how NSTA benefits from interactions with federal agencies in her May 15, 2007, testimony before this committee. OSE also attends the National Association of Biology Teachers meetings, the National Middle School Association meetings, and, on occasion, state meetings of science teachers.

Thank you for this opportunity to discuss NIH's STEM education efforts with you. I will be happy to answer any questions you may have.

ABSTRACT OF TESTIMONY

The National Institutes of Health (NIH) supports the Academic Competitiveness Council's (ACC) goals of conducting increasingly rigorous tests of science, technology, engineering, and math (STEM) programs, leading to the development of highly efficient and productive STEM education systems. The NIH also supports professional evaluation of education materials to ensure that they are meeting the needs of teachers and students. The NIH is committed to playing a leadership role with the National Science and Technology Council (NSTC) in following through on the ACC recommendations, and is currently working with the Council on those recommendations. The NIH will gladly work with other federal agencies to help coordinate science education efforts.

BIOGRAPHICAL SKETCH

Bruce A. Fuchs, Ph.D.

Dr. Bruce A. Fuchs is currently the director of the National Institutes of Health's (NIH) Office of Science Education (OSE). Dr. Fuchs is responsible for monitoring a range of science education policy issues and providing advice to NIH leadership. He also directs the creation of a series of K-12 science education curriculum supplements that highlight the medical research findings of the NIH. The *NIH Curriculum Supplement Series* is designed to meet teacher's educational goals as outlined in the *National Science Education Standards* and is available free to teachers across the nation. The office also actively creates innovative science and career education Web resources, such as the *LifeWorks* career exploration site, accessible to teachers and students across the nation. These resources are available at http://science.education.nih.gov.

Dr. Fuchs is serving on the Education and Workforce Development Working Group of the National Science and Technology Council and on working groups of the Department of Education's Academic Competitiveness Council. He was a member of the K-12 education focus group for the National Academy of Science's report *Rising Above the Gathering Storm*, which was utilized in the Administration's development of the American Competitiveness Initiative, which President Bush introduced in his 2006 State of the Union address. In 2005, the Department of Education asked Dr. Fuchs to serve as the U.S. representative to the Asian Pacific Economic Cooperation meeting on Best Practices in Math and Science Education. For a number of years, Dr. Fuchs was the NIH representative to the Department of Education's National Education Research Policy and Priorities Board. That experience led to his continuing interest in the debate over how to make educational research more effective.

Before coming to NIH, Dr. Fuchs—an immunologist who did research on the interaction between the brain and the immune system—was a researcher and teacher on the faculty of the Medical College of Virginia. He had grant support from both NIH's National Institute of Mental Health and the National Institute on Drug Abuse. He has a B.S. in Biology from the University of Illinois and a Ph.D. in Immunology from Indiana State University. He was born and raised in Springfield, Illinois.