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Before the
Subcommittee on Research and Science Education
Committee on Science and Technology
United States House of Representatives
Hearing on the Nanotechnology in the Schools Act
October 2, 2007

Chairman Baird, Ranking Member Ehlers, and Members of the Subcommittee, it is an honor to appear before you today to testify regarding the Nanotechnology in the Schools Act, H.R. 2436. I am the chairperson of the Oak Ridge High School Science Department, and have taught Biology Honors, AP Environmental Science and Genetics Honors at Oak Ridge for 12 years. As a science educator, I believe that we must offer our students the learning opportunities that will prepare them to lead the world in scientific research. The Nanotechnology in the Schools Act helps accomplish this goal by allowing high school science departments like mine to teach hands-on nanotechnology, which is key to a competitive science education in the 21st century.

Nanotechnology is not a branch of science, like physics or biology. Rather, it is a new field that applies to many different braches of science. Nanotechnology is at the leading edge of chemistry, molecular biology, engineering, and other disciplines. Because it is so fundamental, out students need to understand it. The best way for them to understand it is to experience it firsthand, and that means having access to nanotechnology tools in the classroom. For the first time, these tools are becoming affordable enough – and user-friendly enough – that high schools like mine can begin to consider purchasing them. The Nanotechnology in the Schools Act will make that decision easier, and will help us put these tools in the hands of our students much sooner.

I would like to respond to a series of questions from the Subcommittee:

Please describe your experiences using high-tech scientific equipment in the high school classroom. What benefits do you feel students would receive from having the opportunity to work with nanotechnology equipment?

Students have an inherent interest in most things that are related to technology. At Oak Ridge High School we use equipment which we think is relatively high-tech in relation to biotechnology. We have a Polymerase Chain Reaction (PCR) machine, electrophoresis equipment, centrifuges, UV lamps, and so on. This equipment allows us to actually do the experiments instead of doing them as simulations using pencil and paper.

When students use the equipment they truly understand the complexity and the principles behind the science of biotechnology. They realize how much precision and concentration is required at the bench because it is very easy to make mistakes if you are not paying attention to detail. There is no way they will understand this from a textbook, lectures or simulations.

The use of Geographic Information System (GIS) equipment in AP Environmental Science allows students to get measurements in geology, soil science, water situations, population issues across the globe.

Nanotechnology is becoming a science of the future. Currently, we just mention it in class, and students cannot visualize what a powerful tool it can become. With some basic nanotechnology tools, we will be able to focus more on nanotechnology, and the students will be able to do it themselves.

With the myriad topics high school science teachers must currently cover, how do educators strategically choose new experiences for students in the sciences? How do you integrate the newest concepts into the curricula to give students an appreciation for the new material and an excitement about science, as well as a deeper understanding of the fundamentals?

Of course, the fundamentals have to be taught, and they are. But exposure to advanced technology, innovative software and sophisticated equipment leads to an increased understanding of the material because one can get data which has been generated by them. Nanotechnology is a field that applies broadly to a full range of scientific disciplines, and the concept at its core – that matter can behave in importantly different ways at the nanoscale – is critical to modern science education.

Generating excitement about science at the high school level is crucial if we want American college and graduate students in science programs. Hands-on science is exciting – especially when it involves exploration. Nanotechnology opens up fascinating new worlds within even the most ordinary objects. With an electron microscope, for example, a student can discover the structure of a cell or the pattern of fissures in a piece of metal. For the first time, students can see the microorganisms that share their world – and as anyone who has looked that closely can tell you, it is a compelling sight.

What kinds of professional development opportunities would teachers need to help them integrate nanotechnology into their curriculum and properly use and maintain high-tech equipment?

Professional development is very, very important. Teachers are willing to learn and try new things – we are life-long learners – but without the proper training we will not feel comfortable trying to incorporate the new technology into our class room teaching. Once we are comfortable, we can use the tools in a variety of formats. The Nanotechnology in the Schools Act provides for professional development and teacher education within the grants, and I understand that efforts are already underway to develop curricula based on nanotechnology tools.

Are there problems obtaining funds needed for the maintenance of high-tech equipment? How does Oak Ridge High School address these?

There may be issues with funding in some school systems, but at Oak Ridge we have the Oak Ridge Educational Foundation which helps with these issues. As a department, we also write

grants for extramural funding. It may not be huge sums of money but every little bit helps and it allows us to try innovative teaching strategies, which is sometimes not possible on a school budget. We are fortunate to have these resources available to us, and we recognize that many other schools with talented students do not have such resources. The Nanotechnology in the Schools grants will help those schools as well. That said, adding a provision for maintenance funds may improve the program.

As part of the redesign of our new High School, we are going to have the capability of holding distance learning classes. Even though it is not in place yet, because we are still in the middle of construction, it will happen in the next couple of years. Some of the rural schools around us are not able to offer some of the advanced classes because of the lack of trained faculty and inadequate facilities. We would like to be able to fulfill that gap through our long-distance learning program and holding summer workshops where we will expose those students to our facilities.

Students, no matter at what level, always respond better to situations where they are actively involved in their own education process. As department chair, I have tried to make sure that all students at all levels have the opportunity to use any equipment that is available in the department. It is true that we may not be able to convert every one to become a scientist, but if we are able to change the mind of a handful, who think science is fun, I will consider that a success.

Again, thank you for the opportunity to testify today about high school science education and the Nanotechnology in the Schools Act. I am happy to answer any further questions you may have.

Nita Ganguly

Dr. Nita Ganguly is the Chairperson of the Science Department and holds Masters and PhD degrees in Genetics and a Masters in Curriculum and Instruction. She has worked as a research scientist at the University of Tennessee-Knoxville and the University of California-Irvine. She has been teaching Biology, AP Environmental Science and Genetics Honors at Oak Ridge High School since 1995. At the high school, Dr. Ganguly sponsors the Science Club and Only One Club.

Dr. Ganguly has served as an AP Environmental Science grader and Table Reader and is an endorsed College Board Consultant and National Leader. She has served on the Test Development Committee and is presently on the Development Committee that is working on Redesigning the AP Curriculum for Environmental Science. She has won the Presidential Award for the teaching of Environmental Science and the Siemens Recognition Award for the teaching of AP.

Dr. Ganguly is originally from Kolkata, India and in her spare time enjoys gardening, reading and teaching Indian dance. She is married to Dr. Ranjan Ganguly, Professor of Molecular Biology and Biochemistry at the University of Tennessee and has a son Tuhin, an Intellectual Property Lawyer who works in Washington DC.