

The Nano Advisor

Educational News & Events in Nanotechnology

Spring 2005

Benefits & Challenges of Interdisciplinary Learning

Lawrence University's Nanoscience & Nanotechnology Program

Lawrence University launched an interdisciplinary Nanoscience and Nanotechnology (N&N) program in 2003 with an NSF-NUE grant and a number of local grants. A series of nanoscience experiments has been brought into the introductory chemistry, biochemistry, and physics courses, and a new course, Introduction to Nanoscience and Nanotechnology, is being offered for the first time during the winter 2004-05 term.

Apart from the obvious benefits of studying nanoscience and nanotechnology for its own sake, two key aspects of the program offer tremendous benefit to undergraduate science education at Lawrence: the interdisciplinary nature of the subject matter and the opportunity to do hands-on research.

The Interdisciplinary Challenge

Learning how to learn is a hallmark of a liberal education, and the study of nanoscience is seen as offering a rich opportunity in this regard. "Interdisciplinarity is what makes nanoscience both exciting and challenging," says Karen Nordell, assistant professor of chemistry, who team teaches the Introduction to Nanoscience and Nanotechnology course along with David Hall (biochemistry), and Jeffrey Collett (physics).

"'Interdisciplinary' can be just a buzzword for dabbling, or taking a smorgasbord approach," says Nordell. "However, that's not the same as saying 'I have a question I'd like to answer, and in order to do that, I need skills or information from different disciplines that are absolutely fundamental to answering my question.' Asking people from other disciplines to participate in a very substantive way is hard to do."

To teach from an interdisciplinary perspective, the three professors on the team-taught course believe that they first need to model for the students how to approach problems from different perspectives. Jargon is a major challenge. "One of the reasons we want to get our undergraduates involved in interdisciplinary projects as soon as possible is because they are less hindered by jargon." And then there

is the wide variance of perspectives on a given problem. "Even once the jargon has settled down, it's a challenge to communicate the real meat of the content of those different perspectives."

Scanning Probe Microscopes as Learning Tools

One of the most successful aspects of the course is how hands-on it is. "The kinds of learning experiences that have the greatest impacts on students are when they are designing, conducting, evaluating and modifying the experiments themselves," says Nordell. One class project makes use of four educational scanning tunneling microscopes (STM's). The instruments, which the physics department purchased with a private foundation grant, are used by students and faculty in all the natural sciences at Lawrence.



Physics professor Jeffrey Collett and student with an educational STM (photo: Image Studio).

The instruments are relatively easy to use, yet they are capable of atomic scale resolution, allowing students to quickly see and experience for themselves what is only hinted at in textbooks. Students take a great deal of pride in producing dramatic confirmation of nanoscale structures and principles that were hitherto merely concepts.

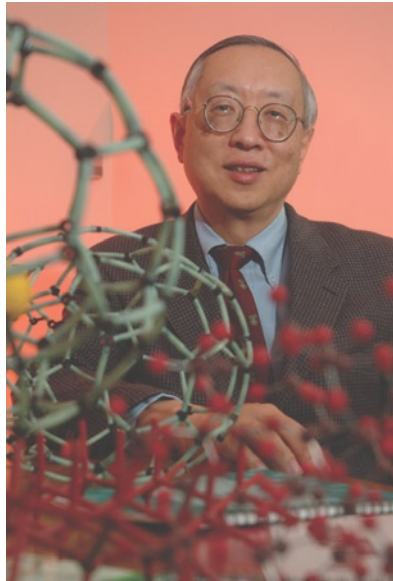
The portability of the compact STM systems lends them well to the Lawrence N & N program's outreach efforts to impact the broader community.

Launch of Major Center for Nano Education

New National Center for Learning and Teaching Based at Northwestern University

The nation's first Center for Learning and Teaching in Nanoscale Science and Engineering (NCLT) has been established at Northwestern University with a five-year, \$15,000,000 grant from the National Science Foundation.

"The mission of NCLT is to develop the next generation of leaders in NSE teaching and learning," according to the center's web site. The center's director, Northwestern professor of materials science and engineering Robert P.H. Chang, goes further: "Our goal is not *just* outreach. Our goal is to help develop curriculum, to really impact science education in this country."



NCLT Director Robert P.H. Chang

The NCLT is a partnership between Northwestern, Purdue University, the University of Michigan, Argonne National Laboratories, and the Universities of Illinois at Chicago and Urbana-Champaign. These five lead institutions will work with additional partners locally and nationally for professional development activities and curricular testing.

NCLT Web Site

The center's web site (<http://www.nclt.us/>) is quickly becoming a wealth of information and resources for educators as well as students. A monthly lecture series on nanoscience and nanoeducation is already underway. Webcasts can be viewed live or downloaded from the archive.

A partnership is being formed with the Network for Computational Nanotechnology (NCN), which develops educational software for teaching nanoscience. NCN learning tools will be used to compliment courses developed at the NCLT.

Course Development

Initially, the center is developing a series of modules that educators can insert into their own curricula. The first modules are being designed for high school level, and they will then be upgraded to college level. The modules are seen as an effective way for the center to get started providing content.

Courses developed by faculty at Northwestern and the NCLT partner institutions are currently being field-tested internally. The goal is to make all curriculum content—modules and courses—available to educators in an on-line library. Curriculum development is, in fact, viewed as a 2-way street: educators are also invited to make their own contributions. By being an NCLT member, educators can have access to course content as both users and contributors.

Professional Development

A variety of programs are planned to develop lead teachers in nanoscale science and engineering (NSE). In addition to an on-going 8-week REST program for college-level educators, there is an annual summer program for high school, middle school, and college teachers which begins this year, at both Northwestern and Purdue. Educators are also encouraged to engage in longer term opportunities, including a year sabbatical at the NCLT.

The professional development programs "will engage teachers in rigorous, sustained, and content-rich professional development in a dynamic interdisciplinary learning community that includes nano researchers, science education faculty and learning technology experts. Teachers will partner with Center faculty to develop state-of-the-art content that will make science and technology more exciting and relevant to students."

To Participate

Professor Chang invites educators to participate by e-mailing the center at nclt@northwestern.edu and indicating their area(s) of interest and expertise.

nclt.us

NSF Funding

Nanoscience Undergraduate Education

Final proposals for the next round of Nanotechnology Undergraduate Education (NUE) grants, which is part of the Nanoscale Science and Engineering Education (NSEE) program, are due April 6, 2005. This year, the number of NUE awards will be roughly 15. This is half the number given in previous years, but the duration of the FY2005 grants is for two years rather than one. The estimated award size is up to \$200,000, for a total of \$3,000,000.

Course, Curriculum, and Laboratory Improvement

The first applications for the FY2006 round of NSF Course, Curriculum, and Laboratory Improvement (CCLI) grants are due May 17, 2005. An estimated 71-99 awards are anticipated, ranging from \$150,000 (1-3 years) to \$2,000,000 (3-5 years), for a total of \$31,000,000. Substantial changes have been made to the CCLI program for FY2006; refer to the NSF site for details.

Simulations & More

An extensive library of nano-related interactive online simulations

and educational resources such as tutorials, seminars, and online courses is available at **nanoHUB.org**, the outreach site of the Network for Computational Nanotechnology (NCN). The NCN is a multi-university, NSF-funded initiative with a mission to lead in research, education, and outreach to students and professionals, while at the same time deploying a unique web-based cyber-infrastructure to serve the nation's National Nanotechnology Initiative.



Multiple AFM/STM instrument packages

Nanoscience Instruments is now offering Nanosurf® easyScan AFM/STM packages to equip your lab or department with multiple instruments. Standard and customized packages are available at an affordable price - with incentive pricing for buying multiple systems. You can obtain several instruments for less than the cost of a "typical" individual AFM system from other companies.

Multiple systems have obvious advantages in larger classes

- more time for students to have hands-on access and less time waiting.

The STM has a straightforward and open design that gives educators the ability to resolve atoms in a classroom. The easy to use AFM features pre-set optics that eliminate laser and detector alignment. With speedy setup for immediate imaging, the AFM will pique the interest of even the most impatient students.

Mobility, ease-of-use, and affordability give the easyScan SPMs a unique advantage for educational use. No other SPM system combines these features.

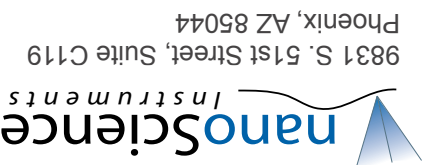
Packages combine the easyScan STM, AFM, and DFM systems. A teacher's manual, special image post-processing and presentation software, vibration isolation systems, and a variety of samples make these packages a special value unmatched by any other AFM or STM.

Contact us for details:
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