

# The Nano Advisor

EDUCATIONAL NEWS & EVENTS IN NANOTECHNOLOGY

FALL 2005

This issue looks at Pennsylvania, a state that has been very proactive in science education by making the advanced teaching and laboratory resources of its higher education institutions available to high school students and others.

## Science In Motion

POPULAR OUTREACH PROGRAM IS A NATIONAL MODEL



*Students engaged in lab activity*

The success of the Science in Motion outreach program at Juniata College in Huntingdon, Pennsylvania has made it a model for numerous other programs in the US. Based on partnerships between higher education institutions and local schools, Science in Motion brings a much needed injection of inquiry-based, activity-oriented science education into the classroom.

Fully prepped instrumentation and labs are delivered to science classrooms in the surrounding school districts, giving students hands-on access to advanced, state of the art equipment. Perhaps the most significant feature of the Juniata model is having mobile educators who go into the classroom and teach, or team teach, the classes. During summer, Juniata hosts 1-week workshops for teachers to learn to use the lab equipment and develop new activities.

Juniata currently has three full-time mobile educators, one each for chemistry, biology, and middle school. There are four vans, one for each subject area, and one exclusively for pick-ups and drop-offs. The vans and mobile educators are kept busy throughout the school year, with far more teacher requests for classroom visits than they can fulfill.

As teachers gain familiarity with a particular lab, they are able to then teach it themselves, receiving the equipment on a pick-up/drop-off basis, freeing up the educators to visit other classrooms. Teachers are very enthusiastic, saying that it is the most significant program they've ever been involved in; they feel more like scientists and are excited to

have up-to-date activities for their students. Science in Motion students have demonstrated dramatic increases in test scores, higher order thinking skills, and the ability to use the same techniques as modern scientists.

The role of the mobile educators is crucial. "Many teachers wouldn't introduce these things to their classes so quickly if they had to wait until they could find enough time to get familiar enough with it themselves," says Juniata Science Outreach Director and Associate Professor of Chemistry Dr. Lorraine Mulfinger. "Having someone there to troubleshoot the equipment is very important in encouraging teachers to use it."

Juniata's chemistry van includes a portable Nanosurf atomic force microscope (AFM), giving high school students hands-on experience with instrumentation that is still uncommon in undergraduate labs. In



*Science in Motion delivery van*

an activity developed for Science in Motion by two Juniata undergrads, students synthesize gold nanoparticles and then measure them with the AFM.

Science in Motion began 20 years ago with two 5-year NSF grants, after which funding shifted to the state of Pennsylvania. The program developed out of a recognition that K-12 science education is severely lacking in funding for lab equipment and supplies, professional development opportunities for teachers, and time for teachers to develop and set up labs. Basic education/higher education partnerships were seen as a way to contribute existing infrastructure and share resources between school districts.

*(con't.)*

*Science in Motion (con't.)*

Over the years, the Juniata model has been duplicated at other colleges and universities in the state, forming the Pennsylvania Basic Education/Higher Education Science and Technology Partnership, a consortium of 11 sites currently serving 200 of the state's 501 school districts. In 2003, it was awarded the Council of State Governments' national Innovation Award for effective government programs.

A similar program, also based primarily on state funding, was started in Alabama. With some initial consulting assistance from the Pennsylvania partnership, it quickly took off, and now serves 100% of the state's school districts. The Science in Motion web site ([science-in-motion.org](http://science-in-motion.org)) has links to numerous other science van outreach programs throughout the US, some based on the Juniata model while others are self-contained mobile laboratories.

## High School Students Get Results with AFM

### CMU SUMMER SCIENCE PROGRAM OFFERS A TASTE OF REAL RESEARCH

A group of high school students at Carnegie Mellon University's summer science program this year obtained publishable results while studying the affects of oxidants and antioxidants on the structure of yeast. The team project was part of the Pennsylvania Governor's School for Sciences (PGSS), a 5-week program for high school juniors on the Carnegie Mellon campus.

Live yeast cells underwent four types of evaluation to indicate the impact exposure to oxidants and antioxidants has on their viability. Two types of experiments involved the application of dyes in order to observe structural changes using UV spectroscopy and light microscopy, and two made use of an atomic force microscope (AFM). The students used the AFM to measure the pores on the cell walls, noting that the diameter increased from approximately 150 nm to 700 nm after exposure to the oxidant diamide. They also evaluated the elasticity of the cell wall by taking force spectroscopy curves with the AFM.



*PGSS instructor Dr. Chris Borysenko with team project students*

"As far as I know, the AFM is the only way to image live cells (at nanometer resolution), which is probably why this aspect of yeast biology has not been studied much," says Christopher Borysenko, PhD, the PGSS instructor for the team project and Director of Carnegie Mellon's Interdisciplinary Laboratory. The students learned to use the Nanosurf AFM instrument quickly, gaining an understanding of the relevant physics principles of AFM and taking images of test samples in a single afternoon. Within a week's time, they were obtaining impressive images of live yeast cells.

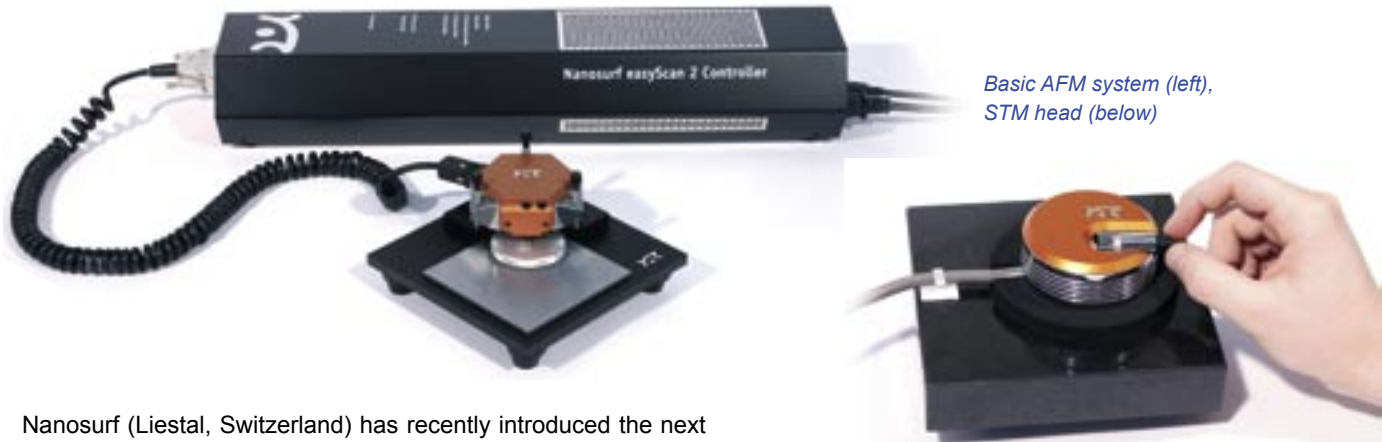
The yeast study was just one part of the PGSS program, which includes a number of intensive courses on subjects not normally taught in high school science curricula. Borysenko's lab project was unique in that it gave students an experience of the full research cycle, complete with its unexpected challenges and seemingly slow moments.

For example, rather than starting right in on a pre-defined experiment, the students spent the first two weeks of the program reading and doing literature searches in order to formulate their own hypothesis. It was only after they had done this, and defined the precise experimental parameters for themselves, that they engaged in the hands-on lab activities. While this was initially frustrating for some, it was ultimately very rewarding to pursue a unique area of research—and obtain publishable results.

The PGSS, a program for accelerated students, is just one of many outreach programs at CMU. Among the others are a mentoring program that teams up undergraduates with high school students for research projects, a program focused on minority students, and a professional development program for high school teachers.

# Nanosurf easyScan 2

EASE OF USE AND PORTABILITY IN A MODULAR SPM SYSTEM



Basic AFM system (left),  
STM head (below)

Nanosurf (Liestal, Switzerland) has recently introduced the next generation of its popular easyScan SPM: the easyScan 2. With over 800 systems currently in use worldwide, the easyScan's ease of use, portability, and affordability have made it an ideal teaching tool. The easyScan 2 goes even further.

More intuitive to use and faster to set up, the easyScan 2 is offered as a suite of modular components, giving users the flexibility to design a system that precisely suits their needs, minimizing costs while leaving the door open for future expansions. A basic AFM or STM system can be expanded to include additional imaging modes, different scanner sizes, enhanced control and positioning capabilities, additional analysis tools, and more.

The ease of use that has made the easyScan such a success in educational settings has been improved further. The software interface has been updated, and changes to the electronics have simplified the setting of scan parameters.

The easyScan 2 integrates options more elegantly, and continues to be the most compact SPM. It takes up far less lab space than other SPMs and is truly portable—it even includes a carrying case that transports the microscope scanner, controller, and all necessary accessories. The basic system is built around a surprisingly slim controller box, and with fewer cables, set-up is now even faster and easier.

Key advantages of the original easyScan series remain the same: pre-aligned optics that eliminate laser and detector adjustment in the AFM, low voltage requirements for both AFM and STM scanners, portability, and Nanosurf's trademark ease of use.

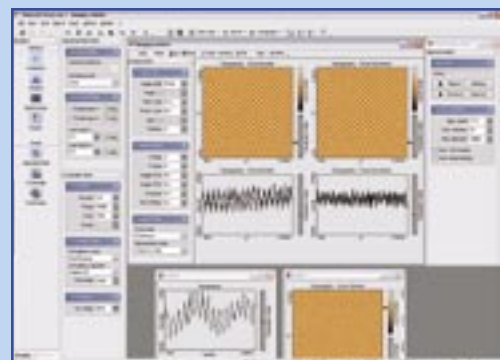
The biggest advancement in the easyScan 2 is the upgrade path from the basic STM all the way to an advanced mode research AFM system. Other new features include an updated

software interface and increased data transfer over the new USB interface, resulting in improved height resolution. Additionally, the AFM's video is integrated into the acquisition software. Another software enhancement is a scripting interface option for customized applications such as nanolithography.

Optional components include a dual-axis video attachment, AFM mode extension module, two signal access modules, a high-precision translation table, Minus K vibration isolation, and a software package for generating reports.

Following its predecessors, the easyScan 2 is still a very affordable choice in the world of SPM instrumentation. Volume discounts are available from Nanoscience Instruments, the exclusive supplier of Nanosurf products in North America.

## Download Free Demo



Download a fully functional copy of the easyScan 2 software with simulated STM data at [www.nanosurf.com/easyScan2\\_demo.htm](http://www.nanosurf.com/easyScan2_demo.htm)

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