

Bergen County Academies: A Model for Graduate-Level Research & Technology in a High School Setting

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Since accepting its first class in August, 1992, Bergen County's magnet high school of choice has emerged as a powerful force in educational reform. This unique school is comprised of individual, career-focused academies which provide a dynamic, specialized, student-centered environment where independent learning and creative problem solving are encouraged at every level. The Bergen County Academies (BCA) began as the Academy for the Advancement of Science and Technology and became the model for the six additional Academies as follows: Business & Finance, Culinary Arts & Hotel Administration, Engineering & Design Technology, Medical Science Technology, Telecommunications & Computer Science and Visual & Performing Arts. The Academies' mission is to serve as an educational model for innovation and reform in the 21st century.

One of the highlights of BCA is its research program. Students from any Academy are eligible to design and execute an individual research project, as an elective, after completing two pre-requisite courses. The students perform research in the fields of molecular biology, genetics, biotechnology, nanotechnology and chemistry. BCA is home to three research labs: Stem Cell, Biotechnology and Nanotechnology, as well as a core imaging facility known as the Nano-Structural Imaging Lab (NSIL). Each lab is equipped with university-level instrumentation suited for its purposes such as a flow cytometer, capillary gel electrophoresis DNA sequencer, RT-PCR, HPLC, GC-MS, probe station, FT-IR spectrometer, UV-VIS and fluorescent spectrophotometers and cell culture facilities.

Opened in May, 2008, the NSIL is a correlative microscopy facility that houses a laser scanning confocal microscope with live cell capabilities and a resonance scanner; a dual-beam, variable pressure scanning electron microscope with focused ion beam, energy dispersive X-ray microanalysis and lithography capabilities; and a transmission electron microscope with a cryo pole-piece, as well as the sample preparation equipment needed for each microscope. The NSIL does not belong to any one academic department, and as such, is easily accessible to students at any grade level and in any Academy.

Students working in the NSIL learn about sample preparation techniques, theory and background on the instruments, imaging techniques and have hands-on training and experience by imaging their own samples. These students typically fall into three categories: students working within BCA on an individual research project which has an imaging component; students participating in a collaborative project with a PI from industry, academia or local medical center; and students completing their Senior Experience internship. During Senior Experience, seniors from other district programs have the opportunity to spend the entire day each Wednesday in the NSIL developing a research project in microscopy. Outside researchers can utilize the NSIL's equipment, at no cost, on the conditions that a BCA student actively participates in the project, is authored on any resulting publication and is allowed to use the data they acquire in a science fair or competition.

Students who participate in the research program have competed in the North Jersey Regional Science Fair, the Young Science Achievers Program, the Siemens Competition and the Intel Science Talent Search (including 11 semi-finalists and 1 finalist). These students have presented at Microscopy & Microanalysis 2009, the 2010 International Stem Cell Conference, the 2010 Material Research Society Fall Meeting and the 2011 Gordon Conference on Stem Cells. In the past three years, students have been published in the Proceedings of Microscopy & Microanalysis (5), International Journal of Botany, Journal of Photochemistry & Photobiology, Connective Tissue Research, Archives of Dermatological Research, Journal of Cancer Molecules, Nucleic Acid Research, BMC Cancer and Angewandte Chemie International Edition.

Through the vision and initiative of the District administration, the Bergen County Academies and its Nano-Structural Imaging Lab are poised to serve as a model for STEM education and as a training ground for the future American scientist.

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Figure 1: Students working on research projects in the NSIL. (A) Two students from the districts Senior Experience on the TEM. (B) BCA students imaging a sample on the SEM. (C) A BCA student imaging a sample on the laser scanning confocal microscope.