

PROJECT SUMMARY

NUE: Development of Multidisciplinary Nanotechnology Undergraduate Education Program at the University of Rochester Integrated Nanosystems Center

Overview: Based on multi-million-dollar federal funding for equipment, the new Integrated Nanosystems Center (URNano) opened at the University of Rochester (UR) in August 2011. This Center is truly interdisciplinary, and involves faculty and students from the Departments of Optics, Chemistry, Physics, Biomedical, Chemical, Mechanical and Electrical Engineering, as well as the UR Medical Center.

The primary goals of the current project are (a) creating a coherent educational program at the UR, promoting collaboration between several UR departments to introduce undergraduate students to the field of nanotechnology; (b) creating a *transformable* model of collaboration in nanotechnology between a university with state-of-the-art, expensive experimental facilities, and a nearby, two-year community college (CC); (c) developing *reproducible* hand-on experiments (“mini-labs”), learning materials and pedagogical methods to educate students with *diverse* backgrounds, including freshmen and non-STEM-major CC students. The same “mini-labs” will be introduced in various UR courses for UR freshmen and sophomores. Based on earlier NSF supported collaboration between the UR and Monroe Community College (MCC), UR and MCC will continue this collaboration to educate nanotechnology students with diverse backgrounds. Establishing the URNano educational program and involving in it MCC will lay the foundation for the future projects of the UR and MCC with other CCs of Upstate NY.

Collaboration with MCC will develop reproducible hands-on experiments for both lower-division, general-education and STEM major MCC students that can be carried out at CCs. STEM major MCC students will carry an additional, nanometrology lab, at the UR. 11 groups/year of MCC students will participate in URNano facility tours including the class 1000 cleanroom (~2,500 sq. feet).

UR will also collaborate with the University of Toronto Centre for Advanced Nanotechnology that offers multidisciplinary courses for nanoengineering degree. A separate program will be created for the UR undergraduate students specializing in different areas of nanotechnology, with a *Certificate in Nanoengineering and Nanoscience* being issued upon program completion. To complete this program, students have to pass through the new Nanoengineering Laboratory course, two other courses which are already offered at the UR, and either a research or design project involving an industrial partner.

The project evaluation will assess the students’ learning, and their attitudes and interest in nanotechnology. UR M. Warner School of Education will participate in the evaluation process. An external evaluator from the State University of NY at Buffalo will participate in evaluation as well.

Intellectual merit: The project addresses one of the most important concepts of modern engineering education geared towards increasingly important technological problems. Nanotechnology has the undisputed potential for creating many new materials and devices with wide-ranging applications. It is important to enable the future workforce to further develop these new ideas, as well as to provide students with hands-on experience in nanotechnology methods and tools for today’s jobs. In the end students will be (1) fluent in nanoscience and nanotechnology terminology, (2) able to define nanoscience, nanotechnology, and nanodevices, (3) able to develop nanotechnology questions and propose strategies to answer them, (4) able to operate some nanotechnology characterization tools (STEM majors), and (5) choose a research career in nanoscience/nanotechnology (STEM majors).

Broader impact: The project impacts a variety of science and engineering students with diverse backgrounds including under-represented groups (~34% of MCC students are minorities and over 50% are women). This project will attract more CC students to the Universities. Dissemination of results will happen through development of a project website on NanoHUB.org, participating in a national network with similar course instructors, presentations and publications. Summer NSF REU/RET programs and interactive workshops including participation in the ALPhA immersion program will provide students and teachers from other institutions, especially CCs and small universities, with an opportunity to learn about affordable “mini-labs” at the UR and MCC. Teachers from the City of Rochester Northwest College Preparatory School serving mostly minority students will be invited to the interactive workshop.